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ABSTRACT

MEDIT, a World Wide Web-based environment, aims at offering complementary support to traditional educational practices. The MEDIT approach distinguishes a set of virtual working spaces and provides the appropriate services for each of them. In addition to a generic hypermedia authoring system, designers implemented advanced tools for multiple view representation of a course and creation and maintenance of private workspaces, in order to stimulate information exchange, interaction, and collaborative work among users. The project, which is currently under evaluation through three undergraduate courses in the Swiss Federal Institute of Technology, is described in this paper. The first section highlights the development of a multidisciplinary Web-based environment, including pedagogical issues in distance education, usability issues of human computer interaction, and technical issues of developing and producing large hypermedia authoring systems. The next section discusses in detail the features of automatic creation of a virtual course space and one of the important pedagogical issues addressed in the MEDIT system--the course customization and views. The final section discusses implications of the distance education implemented and plans for future work. Four figures present screens of the course spaces, the semantic view in tree format, interface to access the semantic view, and private workspace creation. (Contains 11 references.) (Author/AEF)

MEDIT: a Distance Education Prototype for Teaching and Learning

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Abstract: MEDIT is a Web-based environment for various pedagogical issues. It aims at offering complementary support to traditional practices. Our approach distinguishes a set of virtual working spaces and provides the appropriate services for each of them. In addition to a generic hypermedia authoring system, we implemented advanced tools for multiple view representation of a course, creation and maintenance of private workspaces, the aim being to stimulate information exchange, interaction, and collaborative work among the actors involved. The project is currently under evaluation through three undergraduate courses in the Swiss Federal Institute of Technology.

1. Introduction

The last decade is witness of the widespread use of NICT in many different applications such as public administration, medicine, education, edition and press, social services, commerce, etc. Education is one of the fields, which can take advantage of bringing down barriers of time and space with the use of WWW and Internet. A new training method, the Web Based Training (WBT) has raised the interest of private industries who see in it an economic and effective way to train their employees as well as of educational organizations. WBT [Kilby 1998] uses the techniques developed for the CBT (Computer Based Training) coupled with telecommunications networks and with WWW technology (HTML, HTTP, TCP/IP) and adds to CBT's advantages (Multimedia capability, personalized learning pace) the characteristics of the Web such as platform independence, integration of infinite information sources, discussion possibility, easy delivering of training and easy updating of data. From the point of view of the effectiveness of education, what makes the difference between a simple distribution of information and a real class or lesson, is interaction; interaction with teachers, with other students, practical problems, and real examples make learners more motivated and productive in the task they do. WBT offers a priori all the services that make possible the realization of interaction. Numerous projects currently deal with the development of computer-aided learning and tutoring environments to address a variety of pedagogical issues. However, the majority of them focus on the replacement of the role of a tutor with the features offered, without taking care about retraining teachers and students and changing their attitude and their ability to interact effectively with technology. In this context we present the prototype of the environment MEDIT, taking place in the Swiss Federal Institute of Technology (Jan. '97-Dec. '98) that aims at developing a Web-based environment for a variety of pedagogical services [Abou Khaled 1997]. The project intends to offer a valid support to traditional practices in education allowing instructors to decide which level of integration of NICT to use within the traditional course, from an information board for the class, to an instructional medium. The environment provides all the course component a learner is intended to experience in a course [Collis 1997]. To let teachers and students cooperate and easily work with Multimedia documents, specific Hypermedia Authoring Systems are implemented for the needs of the project. The originality of our approach lays on the use of highly structured documents that allows reusing of pedagogical materials in multiple purposes, as well as in an efficient management of all document classes. The environment offers adapted tools for different services; a HAS allows teachers, or administrators, to manage a virtual space for the creation of multiple courses, with rights of access for instructors, assistants and students. When a space has been assigned for a course, the professor can construct his/her own architecture and choose the services he/she wants to offer, via an efficient authoring system. Another service allows to provide four different views of the course: two classical views (by Chapter and by Session), a new one, namely the Semantic view for which the author is the teacher, but also a fourth view Private view completely managed by the students. The paper is organized as follows. [Multidisciplinary approach] highlights the development of a Web based pedagogical environment [Abou Khaled 1998], approaching the problem from a point of view

of involved know-how and sciences: pedagogy of distance education, HAS and HCI research axis. [MEDIT] discusses in detail the features of automatic creation of a virtual course space, and one of the important pedagogical issues addressed in MEDIT system, the course customization and views. Finally, [Conclusion and Future Works] concludes the paper with an argue of the implication of the distance education system we implemented, and future work plans.

2. Multidisciplinary approach

WBT is a science involving several research axes deeply linked to the very nature of the system; we group here the disciplines in three main ones: the first is dealing with the analysis of different components of a course to use them in a distance education environment, and to exploit and enrich all the possibilities of NICT with respect to the real users' needs; we will call this science Pedagogy of distance education. The second science involved is the HAS study, which let create a system allowing users to easily accomplish their tasks (teach and learn) overcoming technological problems. The third science involved is HCI (Human Computer interaction), based on the analysis of user's requirements and judgments which aims at improving and certifying the qualities of the interactive system.

2.1 Pedagogical issues in distance education

The aim of this science is to provide high quality education using NICT; this necessarily involves a retraining of students and teachers. Learners have to become active and have to be actively engaged in creating personal knowledge, changing the degree of interaction and depth of learning. They should be guided in changing their attitude and skills as to became self-directed and self-motivated. On the other side, teachers have to be the intermediary between students and available resources, create new teaching applications and organize instructional materials [Parker 1997]. Traditionally a course is characterized by the following components [Collis 1997]: course content, lectures/presentation, group discussions, learning events (experiments, visits, research etc.), private communication with instructors and classmates, self-study (reading, simulations, exercises), individual/group projects, testing (supervised exercises, exams).
The difficult purpose of Pedagogy in distance education is to discover new pedagogical issues for the course components, to enrich traditional learning. Our attempt in this sense has led to build and design new formative tools taking advantage of current technology. One examples among these issues is the possibility to create new views to access to the course content: by Chapters (traditional, linear access), by Session (chronological access), by Concepts (semantic, transversal access); the use of the combined views allows a great flexibility of presentation of information with respect to the users' needs.
Another feature is the possibility to create a Private working space for students in which they are free to create their own information repository organized and structured as it's most suitable for the individual learning techniques. Services will be detailed later in the paper [MEDIT], as they are realized in the MEDIT prototype.

2.2 Usability issues: Human Computer interaction

HCI is a discipline concerned with the design, evaluation and implementation of interactive computing system for human use [Preece 1994]. The aim of HCI studies is to develop criteria to improve utility, efficiency, effectiveness, usability and safety of the system. In other terms it aims at improving the qualities of the computing system, which are observed and measured through the User Interface. The design process of an interactive system has to be user-center, that is, it has to involve real users in all the phases of development and it has to be highly iterative [Preece 1994]. To be effective, HCI techniques have to follow guidelines and rules both in Design and in Evaluation [Schneiderman 1998]. The hart of the matter is to realize objective criteria on which it's possible to build guidelines and evaluation techniques. In this context it's being developed an international standard, namely the ISO 9241: Ergonomic requirements for office work with visual display terminals. Several studies have been conducted to realize reliable tools to develop and test the interactive systems. In the development of our educational environment we are concentrating on the aspects of evaluation which plays an important role in software development aiming at determining

whether the user's needs are met, and assessing the system suitability for the task. A lot of evaluation techniques have been developed, both oriented in the employment of real users or of experts, and there are arguments that distinguish them [Oppermann 1997]. After a study of the state of the art in this field, we choose to use the ISOMETRICS evaluation questionnaire [Willumeit 1996] developed for formative evaluation of software at the Psychology University of Onesbrück. The questionnaire is based on ISO 9241/10 standard, is developed on experts' as well as on users' opinion and it foresees the involvement of real users (Subjective evaluation).

2.3 Technical issues: Hypermedia Authoring Systems

At present the cost of developing and producing large hypermedia information systems is very high and the process is time consuming. Authoring takes the major part in the development process. The Hypermedia Authoring System (HAS) is an assistance environment intended to help authors in the production of various Multimedia applications. It has to provide a user-friendly interface, involve most adequate tools for text and images processing, and automates most of the production tasks [Abou Khaled 1997][Lowe 1996].
In MEDIT project we created a HAS allowing instructors to produce and organize locally or remotely their courses, supporting collaborative work between different users. MEDIT offers possibilities to organize and structure pre-existing information into sets of WWW pages; it permits also to design pages for readability and user-friendliness with hypertext links, content definition tags, and page layout tags. Finally it provides possibilities to create graphical and text-based navigational tools, banners, and widgets which improve the attractiveness and usability of the course site.

3. MEDIT

MEDIT is an aiding environment allowing the management and the distribution of an on-line interactive course. MEDIT's purpose is to create an environment for tele-teaching and tele-learning, even if actually it can be considered to be a complementary tool for traditional courses. The prototype is being developed for the Fluid Mechanic course taught in the Mechanical Engineering at the EPFL, but developed authoring tools and the new pedagogical issues can be re-used in any educational context.
MEDIT provide a virtual course space model which provides different services (those required in a tutoring and learning environment) for different category of actors (teachers, students and administrators). Our approach for the virtual course space model was based on discussions with experts and users involved in the pedagogical domain (instructors, students, pedagogues, computer scientists, etc.).
We have distinguished a set of course-related activities, the idea being that each of them is often associated with different actors and/or services and, therefore, different tools are needed. This partition was based on the concept of virtual course spaces. The proper specification of the above concepts and their relationships was a prerequisite for the implementation of the system. Every workspace deals with specific teaching services and offers ``tailored" tools. A working space can be viewed as an instantiation of the teaching environment (with its own document classes and tools) to one's specific teaching context or needs. Each space is further divided in different sub-spaces [Abou Khaled 1997].
MEDIT offer a specific HAS for each users, in order to let them easily accomplish their tasks. Teachers and assistants have mainly the task to choose spaces that are interesting for him, as well as to create and distribute course content and exercises, dialog with students, supervise the exercises. Students have to access the course, to learn, to make researches, to self-test, to create their own documents, to be evaluated and to discuss with teachers and classmates. Administrators have to manage the accesses to the space with multiple course and the rights of access for instructors and learners in each course. The majority of existing approaches in web-based tutoring views the course as an indivisible entity, and doesn't allow teachers to have a wide choice of services or a personal configuration of the course. On the contrary, our environment allows instructors to select the spaces they desire for the course and the corresponding virtual course environment is generated automatically (this incorporates on-the-fly creation and compilation of the associated software classes) [Fig. 1].

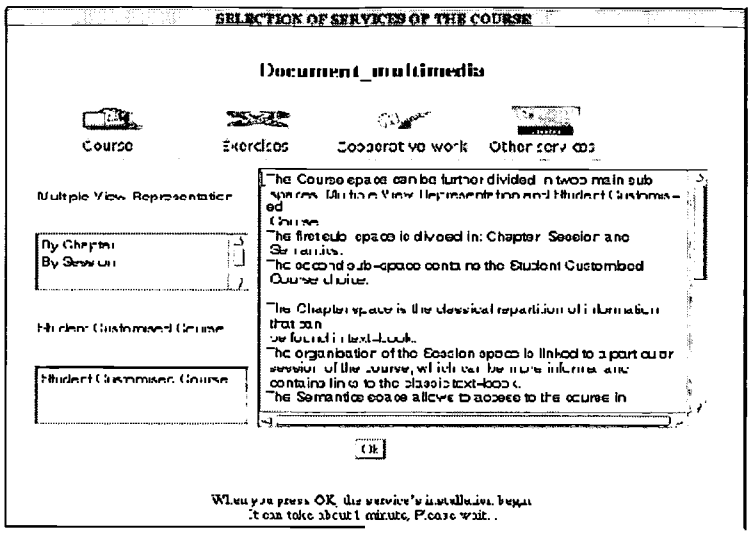

Figure 1: The Course Spaces.

3.1 Multiple course views

MEDIT environment has been designed to implement advanced pedagogical issues that stimulate information exchange, interaction, and collaborative work between actors. It offers to teacher the possibility to reuse the basic information contents in order to build several views with different ways of access. The first view is by Chapter (traditional view with sequential access), allowing easy updating of course content; the second is the Session view with chronological access, and third is the Semantic view with a transversal access, that we will explain here in detail. Semantic view allows readers to select what and how they want to learn, according to their specific needs (for example, the Semantic view of a course could be used as an aiding tool to solve exercises).

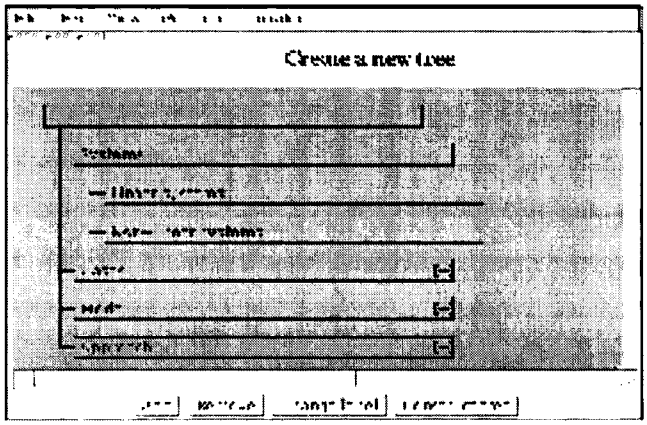

Fig. 2: Semantic view in tree format

To create the Semantic view the teacher has first to conceive his/her view of the course structuring it in a tree-like course representation, based on his/her conceptual view of the subjects. MEDIT offers an easy-to-use tool to support this task [Fig. 2]. Every leaf of the tree corresponds to a course concept or options. Having finished with this task, the teacher has just to click on a button and the system will generate a set of HTML files corresponding to the tree created. By selecting such a file, he/she can then launch an editing tool and use existing views (by Chapter or Session) and external information to edit it as he/she prefers (note that in each such file there is information about the corresponding path in the tree). The students may also access the Semantic view of a course through the interface shown in the left window of [Fig. 3] (the choices appear in this interface are related to the tree constructed by the teacher and are updated

automatically whenever the teacher modifies the tree). The right window of [Fig. 3] corresponds to what the student has selected.

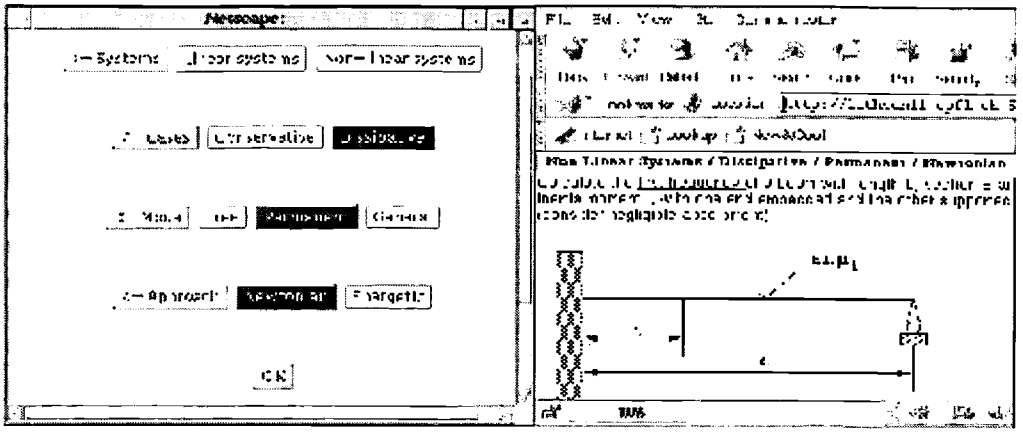

Fig. 3: Interface to access to Semantic view.

In MEDIT, students are viewed as active actors, i.e., they are not only consumers of information but, on the contrary, they are able to enrich the course through questions, notes and discussions, as well as by generating a customized version of the course. Personalized course gives to students an active role and improves their critical attitude. In this context, MEDIT reserves a Private space for each student registered for the course. The space remains his property during the semester. The management of the space is totally autonomous for each student. Features involved here are the easy creation, editing and deletion of the space and its components, access protection capabilities, and attachment of annotations and external existing documents (according to different views, after searching the Web, etc.).

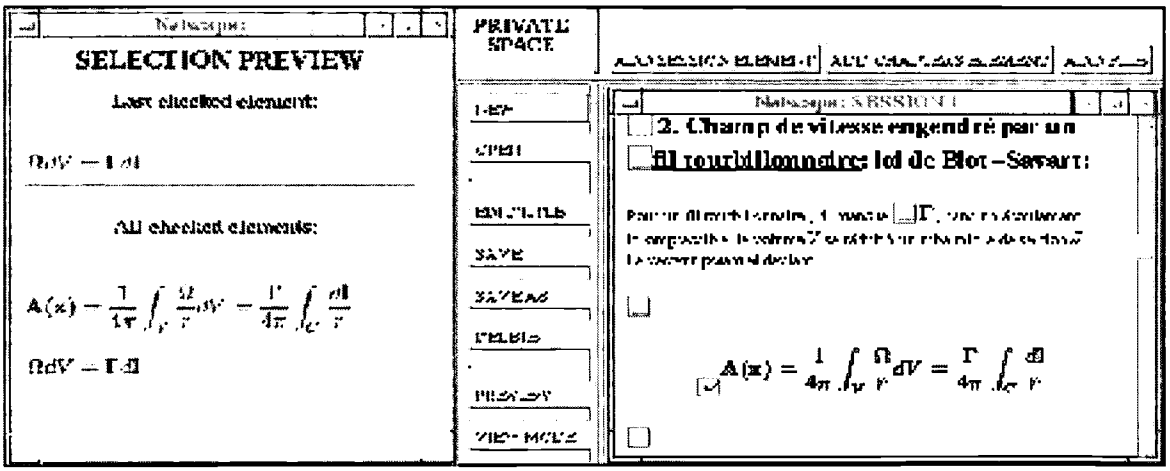

Fig. 4: Creating a private workspace.

In the example shown in [Fig. 4], a student can browse the course documents both by chapter and session. Having selected a link, the corresponding file appears in [Fig. 4 right window]. This file is highly segmented according to a predefined set of HTML tags (the buttons shown are inserted in the existing document on the fly). Finally, the student selects the segments he/she is interested in, and can preview the file he/she has been working so far in the window appearing in the left part of the [Fig. 4]. The Private space makes the student responsible for the content of his/her course and may improve the quality of learning according to their preferred way of learning (namely active, reflective, visual, verbal, and intuitive learners [Felder 1996]).

4. Conclusion and future works

In this paper we described the functionalities, the services, and the new pedagogical contribution of a Multimedia environment for teaching and learning on the Web: MEDIT. The system foresees and autonomous and customized organization of virtual working spaces based on user's needs. We discussed the main features of the different views of the course and of the management system of the course space. The system is currently under evaluation through three undergraduate courses (Fluid Mechanics, Vibratory Mechanics in EFPL and Database in University of Geneva) with the participation of 6 teachers (2 professors and 4 assistants) and about 100 students (20, 30 and 70 in the above courses, respectively). A system introduction (less than an hour for students and about three hours for teachers) were sufficient to get the users acquainted with it. A member of our development group supervised and assisted the users during their first try. The feedback we have received so far was very positive. Teachers were satisfied of the functionalities of the authoring environment and the easiness of its use (locally or remotely), and appreciated the fact that they can still use their preferred editors to create the required course documents, while students liked the idea of having their own Private work spaces. Both teachers and students liked the ideas of course decomposition and multiple views. The system is now being evaluated with HCI evaluation tools (ISOMETRICS) on a sample of users; feedback are collected an analyzed in order to improve the usability of the system.
Future works on functionalities presented in this paper include tracking of the student acts during the creation and maintenance of their private workspaces to extract valuable information about their profiles, interests, and learning attitudes. This information will aid teachers to re-evaluate their course conception, design of exercises and projects, and in general, their course environments.

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