ABSTRACT: The coming years will see significant changes in the educational process. Personal computers, Internet and, in particular, World Wide Web (WWW) will be at the heart of these changes. The use of new communication forms between teachers and students, the possibility of building new learning environments and many other opportunities offered by information technology will dramatically impel change. This paper summarizes some benefits of elearning and describes the use of an environment – AulaNet – used to support teaching/learning through the WWW. AulaNet offers some interesting features that support the creation of new courses in a very simple way. This paper also presents some results of using AulaNet at the Civil Engineering and Architectural Department at Technical University of Lisbon (IST) within a project that embody the experience acquired with the use of this environment at the Catholic University of Rio de Janeiro, Brazil (PUC-Rio).

1 INTRODUCTION

Technology is an agent of change and Information and Communication Technology (ICT) is changing many aspects of human live. For instance, Internet is changing the way people communicate and do business and a major change is also expected in the way people learn. Computer-mediated communication technologies are unique in providing the individual with access to information resources giving him the capacity to participate in an educational process anywhere anytime (Romiszowski, 1997). Communication/information networks are influencing the educational process and there are now a huge number of elearning courses delivered primarily and/or entirely using the WWW.

Because elearning can overcome some traditional barriers related to time and place, there is now a great interest in the development of online courses that could serve students and professionals who might find it a better option than the traditional face-to-face education. This tendency is also driven by the assumption that ICT enhances learning. For example, Kotrlik et al. (2000) reported significant gains in learning when using technology.

Another important aspect is that the use of Internet facilitates collaborative learning (Hiltz 1998). Collaborative learning refers to an instruction method in which students at various performance levels work together in small groups towards a common goal. As stated in Gokhale (1995), collaborative learning fosters the development of critical thinking through discussion, clarification of ideas, and evaluation of others’ ideas. This is a key issue as the advances in technology and changes in the organizational infrastructure put an increased emphasis on teamwork. Workers need to be able to think creatively, solve problems, and make decisions as a team. Therefore, the development and enhancement of critical-thinking skills through collaborative learning is an important goal of the educational process.

In spite of the fact that WWW bring innumerable facilities for teaching/learning, developing online content requires skills on specific technologies such as HTML, JavaScript and Flash, which normally are not familiar to teachers. To overcome this problem there are now several Web-based learning environments that offer many functionalities like storage and management of course contents, tools for communication between users and control of user access. Such environments, hidden from the users the supporting technologies, offering an easy-to-learn and easy-to-use interface.

In this paper a specific environment - AulaNet - is described. This Web-based learning environment is used at the Civil Engineering and Architectural Department at Technical University of Lisbon (IST) within a project that embody the experience acquired with the use of this environment at the Catholic University of Rio de Janeiro, Brazil (PUC-Rio). The main aim of this project is to evaluate the impact of
2 AULANET – A WEB-BASED LEARNING ENVIRONMENT

AulaNet (Lucena et al. 1999) is a freeware environment for the creation, delivery and administration of Web-based courses. It is based upon a groupware approach and the Software Engineering Laboratory of the Catholic University of Rio de Janeiro (PUC-RIO) has carried out its development since June 1997.

The AulaNet environment (version 1.3, available for download at http://guiaaulanet.eduweb.com.br/english/index.htm) offers a stereotyped interface for accessing courses on the Web. This interface is made up of a menu that is presented graphically as a remote control unit, which provides access to the course’s services, and a central window where the learner interacts with the course’s contents, with the instructor and with the other learners. To access AulaNet the user must have a Web-browser and some plug-ins installed in the computer.

AulaNet considers three main actors: the learner, the teacher and the administrator. The administrator is responsible for the operational tasks, like accepting learners and teachers registration, publishing courses, defining the general environment interface and so on. Teachers can have two main roles coordinator and instructor: the coordinator is the author of the course, defining and configuring the content and the services that are made available to learners; the instructor is the person who motivates and organises the group, guiding learners to the achievement of the course goals.

During the creation and updating of a course teachers are able to select and configure the services that they want to make available to the learners within the course’s workspace. AulaNet services are divided into communication, coordination and cooperation services.

2.1 Communication services

The communication services include:
- tools for individual electronic mail exchange - Contact with the Teachers, and with the entire group - Discussion Group;
- an asynchronous text discussion tool (news) - Interest Group;
- and a synchronous text conference tool (chat) - Debate.

Contact with the Teachers is a channel for contacting members of the course’s teaching staff. The messages are sent through electronic mail to the teachers (coordinators and/or instructors) and are kept available in the environment for subsequent consultation.

The Discussion Group service acts like a mailing list and is used to communicate with the entire class. When a message is posted on this service, besides being filed within the environment, it is sent to the electronic post office box of all members of the group. As a result everybody is aware of the activities of the Discussion Group, even if they do not enter the environment. In the environment the messages are shown as a chronologically sorted list.

The Interest Group operates like a conferencing system where it is possible to answer a message, and the answers are attached below it forming a threaded discussion. This structure permits the organisation of a discussion by topics, with related messages remaining compartmentalised below the original topic message. This is different than the Discussion Group service where messages about different topics are mixed together, often making it hard to reconstruct the linkages.

Finally, the Debate service is a real-time conversation through text chat. Since it is a synchronous communication tool, everybody has to be connected at the moment of the debate.

2.2 Coordination services

These services include:
- notification tools – Course News and Course Agenda;
- a tool for the basic coordination of the flow of the course work - Lesson Plan;
- and assessment tools - Test, Task and Exercise.

Teachers use Lesson Plan to structure the course’s educational materials in classes. Classes follow an order that is suggested, but not imposed, indicating a basic flow for the course. Course’s educational materials can include video streams, audio trails, slide presentations or supplementary texts that learners may consult at any time.

2.3 Cooperation services

The cooperation services include:
- tools to provide the means for cooperative learning, problem resolution, and course co-authorship, both for teachers - Teacher Co-Authorship, and for learners - Learner Co-Authorship;
- a list of extra contents that are not associated with any specific lesson - TextBook;
- and references to textbooks and other materials - Bibliography.

The Learner Co-Authorship Service is used to include content developed by learners after subjected to teacher examination.
The Bibliography and TextBook services are an alternative way to the Lesson Plan, through which teachers can present additional educational content to learners.

3 AulaNet AT THE CIVIL ENGINEERING AND ARCHITECTURAL DEPARTMENT (IST)

Besides AulaNet, there are available other Web-based learning environments also offering a robust set of features, such as: Virtual-U (http://www.vlei.com) IntraLearn (http://www.intralearn.com), TopClass (http://www.wbtsystems.com), and WebCT (http://www.webct.com).

Comparing and evaluating such systems is not an easy task as each one is organized and works in a different way. For example, AulaNet is based on a groupware approach and that differs from other learning environments such as WebCT or VirtualU that are based on a traditional school physical metaphor (Fuks 2000). Zaina et al. (2001) and FutureU (2000) analyzed and compared some of these systems taking into account lists of important features.

The decision of adopting AulaNet at the Civil Engineering and Architectural Department at IST was driven by the following main reasons:
- the environment has a very user-friendly interface and its use does not require specific training neither for teachers nor for learners.
- it has all the needed features to complement the target courses.
- it is possible to download and install the system without any costs.
- AulaNet’s interface is written in Portuguese, native language of the target students.

Besides these main reasons another important aspect that took a decisive role in this selection was the fact that one of the authors experienced the use of AulaNet at PUC-Rio for online courses and as a complement for face-to-face courses.

At PUC-Rio, the students were very motivated especially for the use of communication services to discuss the topics. The teachers compared face-to-face classes with online classes of the same subject and observed a deeper critical discussion at online classes. The same was observed when the environment was used to complement face-to-face classes.

Although it is clear that online interaction improves critical thinking and evaluation, we are also interested on the hypermedia characteristics of the Web, which we believe that besides motivating students also make the understanding of some subjects easier. Therefore we are developing an elearning project at ICIST, a research and development center of the Civil Engineering and Architectural Department, for complement traditional face-to-face courses.

3.1 The elearning project at ICIST

The discussion about using Web-based education environments to support learning/teaching in the Civil Engineering and Architectural Department at IST showed that although the majority of teachers considered it important, they were not enough motivated to embrace it immediately. So, it was decided to start slowly disseminating the online culture in specific disciplines and small groups of students as experiments. The strategy is proving the online efficiency at small modules, developing materials for small topics of each teacher that is interested on the experiment. Then, more and more content material will be added until the teachers are really engaged in this movement.

Next semester, a few disciplines will use the environment as repository of content material. In addition, the environment is going to be used at the interactive level as complement for one discipline of the course: Computer Programming.

3.2 The Computer Programming discipline

The Computer Programming discipline is the first course where students acquire basic knowledge on computer science.

During the last editions of this course some ICT tools were already used to support learning/teaching:
- a Web page with all the information needed by students including the course material that was available for download;
- and a specific email used by students to ask questions and send teachers proposed assignments. These assignments were evaluated and graded.

From the use of the Web page it was possible to realize that it was too static and that it would be necessary to promote interaction between students and between students and teachers in order to improve learning. As developing additional tools seemed a very time consuming alternative, it was decided to conduct an experiment using a Web-based learning environment – AulaNet. To quantify the expected contribution of these resources only a random group of students will access the environment. All other students will continue to use the Web page and email service as in the previous years. A statistical analysis comparing the final grades obtained by the two groups will be conducted at the end of the semester.

For the purpose of the experiment the following AulaNet services have been chosen:
- Contact with the Teachers - this service replaces the previously mentioned email to contact teachers. The advantage of using this service is that messages posted by students are kept available in the environment.
- **Discussion Group** - this service will be useful for sending general messages for all course participants. These messages are stored in the environment and also sent by email to all participants.

- **Interest Group** - this service operates as a forum where students can discuss course topics. This is the best option for asynchronous discussion of topics.

- **Debate** – this service is used to allow real time (synchronous) interaction among students.

- **Course News** - this service is used to publish messages connected with course organisation similar to what is done in the existing web page.

- **Course Agenda** – this service is used to chronologically organize the course activities.

- **Lesson Plan** - the course material is organised in lessons and published using this service.

- **Test and Exercise** - these services are used to implement formative tests.

- **Bibliography** - to publish the book references of the course.

Although some of these services are similar to features already offered by the Web page the possibility of iteration between students and teachers that is expected by the use of **Contact with teachers, Discussion group, Interest group** and **Chat** might have a great impact in student’s motivation.

**Discussion Group** will be limited only to general (and important) messages and **Debate** will be considered only for student-student interaction, as the number of students enrolled in the course is usually greater than two hundred.

Another important aspect that is being covered is the publication of formative tests - tests where the results of the test do not contribute to a student’s final grade but are used to assist the student’s learning. These tests aim at contributing to help teachers to identify areas more difficult to students.

**4 CONCLUSIONS**

This paper presented an overview about the use of AulaNet to support Web-based learning/teaching. It also described a research project on elearning where it is expected to evaluate the benefits of using such technologies at the Civil Engineering and Architectural Department at IST.

As a first experiment, by the time of this writing, it is still going on, it is not suitable to present final results. Nevertheless and from the experience lived at PUC-Rio, it is possible to witness the feasibility of the approach used in AulaNet and to stress the importance of the contribution it can offer to complement traditional face-to-face courses with on-line components. Using a groupware approach in AulaNet is an innovative aspect that really contributes

to students' performance. The fact that the available services are presented to students as a remote controls unit also proved to be a good feature.

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**REFERENCES**


