Applying Digital Information Technology to Education: A Web-based Course

Carlos J. P. de Lucena, Hugo Fuks, Carlos Laufer, Marcelo Blois, Ricardo Choren,
Viviane Torres, Rodrigo L. de Assis, Fabio Ferraz and Gustavo Robichez

Abstract — **This paper describes a laboratory course developed by the authors at the Computer Science Department of Catholic University of Rio de Janeiro (PUC-Rio) using the AulaNet environment. AulaNet is a groupware learning environment for creating and attending distance courses through the Web. The course consists of teaching/learning how to apply information technology to education using an environment that applies information technology to education. The purpose of this work is to show which and how groupware tools can be used to support, animate and manage a cooperative learning process.**

Index Terms — **web-based learning, groupware, cooperative learning.**

I. BACKGROUND

The society is changing. This change is characterized by fast and ongoing evolution in all the knowledge areas, more specifically in the technological area. Mastering the skills and understandings needed to keep pace with all those changes is crucial. Therefore, the education (training) is a key issue in this new society.

However, learning is an activity traditionally associated with the formative (initial) years of an individual's lifetime. Education and training are seen as a school-wall confined and "once and for good" activity, that should theoretically equip a person for the rest of his life.

Much emphasis must be placed on "learning to learn", as a response to the realization that learning will be a lifelong occupation, largely occurring outside of the formal educational institution [1]. It is important to create and foster environments where learning is actively encouraged and facilitated. Furthermore, it is important to create a critical mass, a community, to successfully deploy web-based learning.

II. LEARNING ENVIRONMENT: AULANET

Having this in mind, we have been developing AulaNet—a Web-based groupware learning environment for creating, participating and managing distance courses—since June 1997 at the Software Engineering Laboratory (LES) of PUC-Rio [2, 3, 4]. AulaNet's approach is based on the cooperative work relations that happen during the learners' interactions with their instructors, peers and didactic contents.

The Web is an emerging technology in the Information Society. It can be used to provide opportunities to develop active and customized learning experiences. One of the great values of the Internet, and in particular of the Web, is that it brings the learner face to face with an ever-expanding universe of digital information [5].

The main idea of AulaNet is group learning. Therefore, AulaNet is developed groupware for learning purposes. To learn in this groupware environment, a person has to share ideas (communicate), keep pace with the group (coordinate) and work together (cooperate). Therefore, the groupware structure of the environment is divided into communication, coordination and cooperation mechanisms.

The communication mechanisms provide the features that allow information to be shared or sent to teachers and learners. These mechanisms comprise e-mail, newsgroup, mailing list, chat and an instant messenger.

The coordination mechanisms provide the means for time and competence management. They include a scheduling tool, a basic course flow tool, assessment tools (task and exam execution) and a tool for learners' contribution track. The cooperation mechanisms provide the means for joint cooperation in learning, solving problems and undertaking tasks, that is, the means to share ideas and information.

In AulaNet, cooperation [6] should be understood as preparing the shared workspace for the learners' interaction and also as making room available for other people (invited teachers and learners) to prepare content that may be incorporated into the course later on.

The selection of mechanisms enables the separation of content from navigation. By defining the content of a didactic content separately from its navigation, AulaNet makes it much easier to reuse content in other educational web environments.

III. COURSE SUMMARY: INFORMATION TECHNOLOGY APPLIED TO EDUCATION

Information Technology Applied to Education (ITAE) is a graduate elective course of the Computer Science Department at PUC-Rio. This course introduces the students to the concepts of applying web-technology for educational purposes.

Professor Lucena and Professor Fuks, heads of the AulaNet project, are the teachers of ITAE. The course was originally conceived to serve as a test drive for AulaNet. ITAE syllabus covers digital communication, groupware, web-based instruction, learningware, interactive multimedia and knowledge communities. ITAE intends to create an ever-growing community about web-based instruction.

This course was first given in the first semester of 1998 and its structure has evolved since then. Initially, ITAE was structured as a once a week face to face seminar and a once a week debate using chat. In this embryonic edition of ITAE, the course had almost no didactic contents. The course contents were being generated during the class and the chat discussions.

Now, the course is an anytime participation with a once a week gathering session, all using AulaNet. In this new structure, the course already has a basic content skeleton, composed by the contents created during its earlier editions. This shows the evolutionary aspect of a community generation, that is, there is a culture being passed ahead to the course cohorts.

The learners do everything online, from consuming the course contents to working with their peers through a mailing list, for instance.

IV. AULANET ITAE DYNAMICS

AulaNet offers a standard web interface for online courses attendance. This interface is made of a main window and a remote control. The main window is where the student interacts with the didactic contents, with his instructor and with his peers. The remote control is a high-level navigation facility tailored by the teacher previous selection of the communication, coordination and cooperation mechanisms.
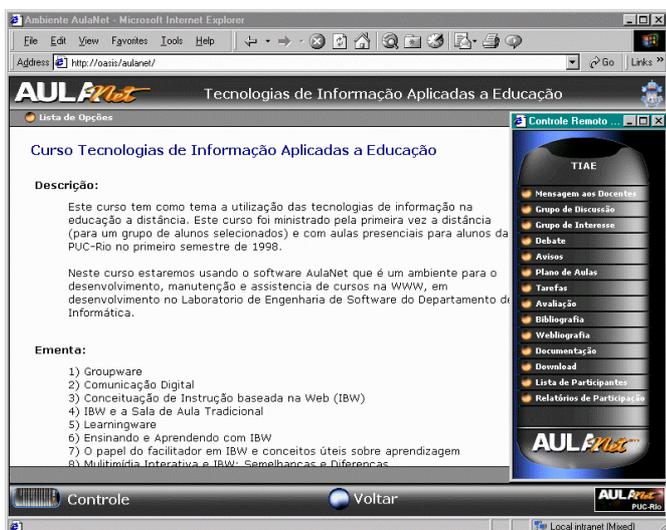

Fig. 1 AulaNet Course Attendance Interface (in Portuguese).

The course methodology is basically as follows: every week a lecture introduces a new subject. The lecture already contains the basic didactic contents about the subject. For each subject, the group elects a "presenter" whom is the learner in charge of leading an asynchronous discussion about the subject. Then, there is a synchronous debate with the whole group.

After discussing all the subjects of the course syllabus, the group identifies some major topics of interest, which shall be deeper discussed. The dynamics of this methodology and how it is achieved using AulaNet are described in the next subsections.

A. Enrollment & Participation

Initially, AulaNet did not have the concept of classes (sub-groups). Thus, in the first editions of ITAE, all the learners participated of the same group. The registration process was made directly through the environment. As the course had no restrictions for the audience, many people asked for enrollment, generating a large group of learners.

In the last edition of the ITAE, AulaNet already had a mechanism of classes. The group of enrolled learners was divided in sub-groups, facilitating the coordination. The problems of dealing with a large group of learners in ITAE are discussed later.

B. Overall Contents

The first main screen of a course displays its overall contents, which are name, description, syllabus, code, methodology, institution, department, coordinator teacher, a list of teachers who are co-authors and a list of teachers who are instructors. Meanwhile, the remote control screen lists the services (generated by the mechanism selections) configured for ITAE.

C. Communication Services

ITAE uses the following communication services: contact with the instructor, mailing list, newsgroup, chat and peer contact. In fact, the course uses all the communication services in the environment.

The teacher contact service is an e-mail tool, which serves as a hot line to reach a course teacher. In ITAE, this service is used to handle the learners' doubts concerning the didactic contents. The mailing list is where the presenter of the week posts the initial seminar and where the group discusses the subject. The chat is used to make a synchronous debate about the subject in discussion (this is, in fact, the weekly gathering of the group).

The newsgroup is used to develop the five major topics selected after the presentation of all the subjects of the course. At this phase, the group is split into five subgroups. After each subgroup develops its topic, they build some contents that may be used to create a complementary lecture in the course.

Finally, the peer contact tool is used with no specific purpose in ITAE, allowing online group members to contact each other instantaneously (similar to products like ICQ and AOL Instant Messenger).

D. Coordination Services

ITAE uses the following coordination services: scheduling, basic flow and task assessment. It does not use the exam assessment tool and the learner contribution-track tool provided by AulaNet.

The scheduling tool is used as a billboard telling the group what, where and how are the upcoming course events. It is also used as a reminder of the course methodology. The task tool is the learning outcome assessment method. The course instructors give some tasks to be performed by a learner or a group of learners. The learners, then, are assessed according to their performance.

The basic flow tool is used to create the course lectures' initial structure—the lecture plan. The course teachers prepare the didactic contents and divide them into lectures. These lectures follow a suggested order, indicating a flow for the course. Three aspects should be pointed out:
1. the lectures indicate the main course subjects (those that will be discussed weekly, for instance);
2. the didactic contents of a lecture are subject limited and constitute the main contents of the course;
3. the flow (order) suggested by the instructors may not be followed by the learner.

The lecture plan does not operate as a workflow, allowing free navigation through the course lectures. There is an ongoing work [7] to create a workflow machine to monitor the learners' interactions with the lecture plan providing some navigation freedom.

E. Cooperation Services

ITAE uses the following cooperation services: web reference, bibliography, documentation and teacher co-authorship. It does not use the download tool and the learner co-authorship tool provided by AulaNet.

The web reference, bibliography and documentation mechanisms are used as other means of presenting didactic contents for the learners. A web reference links the course to a site outside the AulaNet environment. Documentation is a content similar to those used in a lecture. Bibliography is information about a textbook reference of the course.

The teacher co-authorship mechanism is used to allow other teachers to help facilitating the learning process. This mechanism is useful since other teachers help dividing the class group into smaller subgroups resulting in more valuable learners' participation and in more elaborated didactic contents' creation.

V. ITAE CONSIDERATIONS

After four semesters, ITAE has been under constant development, and some considerations were taken about the benefits as well as the limitations of using web technology in distance courses.

A. Cost of Development

The time and the effort needed to develop attractive didactic contents and to animate a web-based course is, at first, substantial and possibly prohibitive. However, as ITAE is an incremental course over the time, most of the didactic contents is re-used, indicating a progressive reduction of its cost.

The cost of participating in the course, unfortunately, seems to keep constant, if not growing. Interaction demands attention, thus the teacher has to be an effective facilitator to promote the learning process at distance over the web.

B. Learner Participation

Despite some initial problems caused by the learner's little experience with web-based education (and with AulaNet) and by shyness, the learners' participation had been satisfactory.

The course methodology itself required intense learner participation, creating a learning environment with more cooperative experiences than the traditional classroom. The exposure introduced by AulaNet made the learners become more active.

C. Group Size and Overload

The first two editions of ITAE had over 100 learners in a single class. This made it very difficult to create a cooperative learning environment with effective teacher facilitation and learner participation.

Since the course was based on a mailing list, hundreds of mails were posted during a week, making it really hard to read most of them before the synchronous debate session. This communication overload required group subdivision, with each subgroup having its own instructor (facilitator teacher).

From the third edition of the course on, each group had a range of 20 to 25 learners. Without communication overload, the quality of the learners' contributions increased, given that all the learners were able to effectively participate and to add value to all the contributions posted.

D. Learning Outcomes

The learners' assessment in ITAE is done through the contributions made all through the course and through the creation of a didactic content about the subject of the newsgroup the learner participated in.

In fact, AulaNet has an assessment tool that was not used in ITAE as well because it was important to assess the learners as a group. Thus, the teachers have been trying to involve the learners in a group project where they can be exposed to different situations, instead of translating a conventional assessment task to the web.

To evaluate a contribution might turn into an arduous task. The teacher needs to measure the group as a thermometer. In ITAE, the teachers are aided by the group comments about a contribution, that is, the group (participating actively) usually indicates if the contribution is really significant.

E. Other Considerations

There are some other considerations that we have pointed through the development of ITAE, including:
• copyright issues;
• learner misbehavior;

- technical difficulties, specially about the use of plug-ins to some contents;
- some environment limitations.

VI. CONCLUSIONS

The web can offer a variety of benefits for the learning process, including:
- easy access to didactic contents;
- interaction (learner to learner and learner to teacher); and
- group learning.

Learning environments, such as AulaNet, provide the means to structure the web features to the learning process. The ITAE course is a project, developed in AulaNet, to discuss about information technology applied to education using an information technology environment.

ITAE never had a "traditional" edition (a regular paper based edition), being developed directly for the web. This aspect brings all the advantages and the limitations of the web. The cost of developing the course was significant at first, decreasing in its the following editions, through content re-use. There was communication overload and the group of learners had to be limited. But there was a great amount of participation and engagement in cooperative tasks.

Moreover, because ITAE never had a traditional edition, it was not possible to verify if the use of the Web increased or not the results of the learning process. Anyway, the group (teachers and learners) considered the results achieved with AulaNet satisfactory.

From the point of view of the AulaNet project design, the results were excellent. For example, at no moment in the ITAE course, a learner looked for the teacher or for other learners without using AulaNet. This demonstrates that, despite of the initial problems of "acclimatization", AulaNet reached its main goal: support a learning process entirely through the Web.

All authors' affiliation: Catholic University of Rio de Janeiro, Computer Science Department, Software Engineering Laboratory. Address: R. M. S. Vicente 225 – Gávea – Rio de Janeiro – Brazil – ZIP: 22453-900. Fax: +55 21 2592232.

Carlos J. P. de Lucena, lucena@inf.puc-rio.br; Hugo Fuks, hugo@inf.puc-rio.br; Carlos Laufer, laufer@inf.puc-rio.br; Marcelo Blois, blois@inf.puc-rio.br; Ricardo Choren, choren@inf.puc-rio.br; Viviane Torres, viviane@inf.puc-rio.br; Rodrigo L. de Assis, lassis@inf.puc-rio.br; Fabio Ferraz, ferraz@inf.puc-rio.br; Gustavo Robichez, guga@inf.puc-rio.br.

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