AulaNet Technologies: Future Trends

Carlos J. P. de Lucena, Hugo Fuks, Ruy Milidiú, Carlos Laufer, Marcelo Blois, Ricardo Choren, Viviane Torres, Fabio Ferraz, Gustavo Robichez and Leandro Daflon

Abstract **— In this paper we present AulaNet, an environment for the creation and maintenance of Web-based courses. It differs from other Web-based instruction environments because it lacks the physical elements of the traditional schools, lying over the trivet communication – coordination – cooperation. We also present some future trends in the development of this learning environment, focusing the creation of knowledge communities.**

Index Terms **— Web-based Instruction, groupware, learningware, knowledge communities.**

I. INTRODUCTION

Web-based instruction (WBI) is an innovative approach to delivering instruction using the Web as a medium. The Web 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 [1]. Empirical evidence demonstrates the value of cooperative learning when compared with individual learning (e.g., [2]–[3]), and there has been an explosion of interest in cooperative on-line learning and teaching.

The main driving factor for Web-based training is the necessity to find methods of bringing training directly to the desktop in a continuous just-in-time way. We need to understand how established instruction systems (eg: classrooms) can migrate to a more open organization, in which part of the lecture could perhaps be given according to the "dynamic community model for apprenticeship".

In this paper, we present AulaNet, a groupware WBI environment with a cooperative approach. We also give some description of future trends in the development of the environment to allow course evaluation, student knowledge flow, content re-use and student engagement with simulation.

II. AULANET

AulaNet is a Web-based groupware learning environment developed in the Software Engineering Laboratory (LES) of the Department of Computer Science at the Catholic University of Rio de Janeiro (PUC-Rio), for creating and attending distance courses. The objectives of AulaNet are to adopt the Web as an educational environment; to foster a workable transition from conventional classrooms to virtual classrooms, giving the opportunity to reuse existing educational material; and to create knowledge communities [4].

AulaNet differs from the majority of digital learning environments available because it is based on a groupware approach while most of the other related environments virtualizes the traditional school physical metaphors: corridors, blackboards, general office, classrooms, library, etc. We believe that learning and the intellectual aspects of working are becoming one

and the same thing, based on the idea that in order to cooperate, people have to become coordinated, and in order to become coordinated, people have to communicate. Hence, the key words of our approach are *communication, coordination* and *cooperation*. In addition, AulaNet makes a clear distinction between content and navigation.

The main beneficiary of this environment is the teacher. We believe that a teacher should master his subject domain and not necessarily be obliged to know a lot about the Internet. The teacher's task is to create good quality instructional material, leaving the Internet navigation programming to the environment. With AulaNet the teacher does not need to know any kind of Internet programming languages to create, update and give distance courses. AulaNet fosters the separation of content from navigation releasing the teacher from the programming task. Therefore, in principle, there should be no burden migrating content developed for AulaNet to any other similar system.

Based on the availability of tools tested by the LES, the following preliminary check-list was proposed: (a) publication of the text book as hypertext; (b) publication of texts associated to the lectures; (c) recording lectures with the instructor present; (d) online transmission of lectures with the instructor present; (e) publication of students' projects; (f) forms of assessing students (exams, etc.); (g) use of slides plus description of slides; (h) interactivity on the Internet; (i) use of news; (j) form of online support to the organization of the course; (k) students as information providers; (l) use of animation, video etc; (m) use of software by the students; (n) lectures in the laboratory and (o) definition of development of the learning process.

A. Mechanisms and Services

To provide all these features, AulaNet offers a set of communication, coordination and cooperation mechanisms, so that the teacher can customize his course according to the intended goals of the learning process.

The communication mechanisms provide the features that allow information to be shared or sent to teachers and learners. These mechanisms include e-mail tools (simple e-mail tool and a discussion list tool), an asynchronous text based conferencing tool (newsgroup facility) and a synchronous text based conferencing tool (chat).
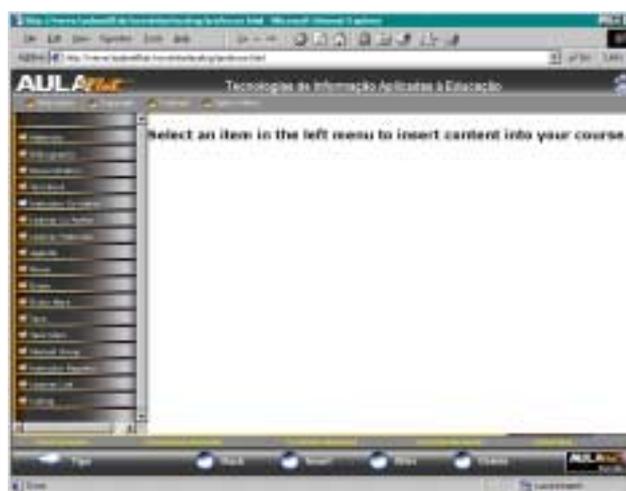

Fig. 1. AulaNet's Teacher Interface.

The coordination mechanisms provide the means to make sure that the class participants (team) work effectively and meet their goals. The environment offers basic scheduling tools (calendar management) such as an agenda to set up events like chats and to announce deadlines and course news to serve as a billboard about developments on the course. These mechanisms also offer competency based coordination tools (assessment), such as tasks and a tool to create and correct on-line exams, named Quest [5].

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 should be understood as the preparation of material by the teacher for the learners' consumption and also, in a constructivist way, making room available, for other people (invited teachers and learners) to prepare material that could be incorporated into the course later on. Among these mechanisms there are tools for material upload and teacher and learner co-authoring assignment.
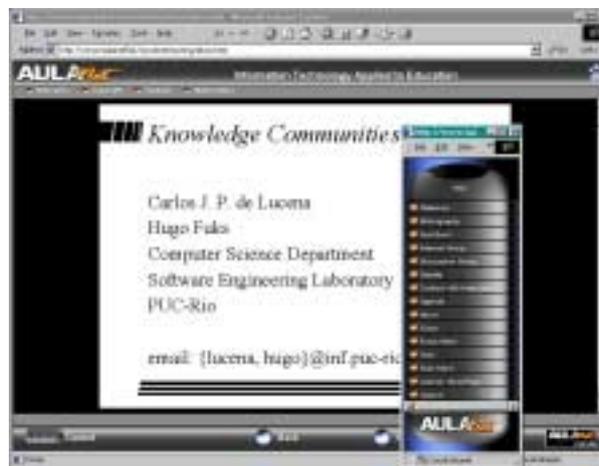

Fig. 2. AulaNet's Learner Interface.

The learner's empowerment is epitomized by the remote control. It offers the menu of services—high-level navigation facilities—tailored by the teacher's previous selection of the communication, coordination and cooperation mechanisms. Learners are very familiar with remote controls for their pervasiveness in home electronic appliances. Using the remote control, learners choose between different services like contact with the author, discussion lists, interest groups, and agenda etc.

III. FUTURE TRENDS

Currently, AulaNet version 1.9 is available both in Portuguese <ead.les.inf.puc-rio.br/aulanet> and English <english.les.inf.puc-rio.br/aulanet>. It has over 1800 registered participants (≈ 3% of those with teaching privileges) and it is being used to offer almost 40 Web courses. The environment was developed with CGI scripts, using CGILua [6] language. A new version, using Java Servlets [7] technology, is under development and will also focus other aspects, which will be described in the following sections.

A. Course Statistics

Reference [8] discuss assessment issues in three main areas: network design and structure, social interactions, and individual learning outcomes. Assessment of the design and structure must take into account the size of the learning groups, and the tasks undertaken by the participants. Assessment of the social interactions addresses things such as pattern of individual participation, response times and varying involvement by participants throughout the course. Assessment of learning outcomes takes into account the educational outcomes for the learners of the course. The two first areas are concerned with course evaluation and the last area is concerned with learner assessment.

At present, the assessment of learning outcomes is made with the competency based coordination mechanisms. To collect the data necessary to perform the design and the social interaction assessment, AulaNet will provide a mechanism of Course Statistics. Among these statistics, the teacher will have, for instance, data about total and average utilization of the materials and of the communication tools of the course.

These data give parameters to know about the tasks performed by the learners, to measure the involvement and the response time of the participants and to identify some patterns of interaction. For example, the teacher will be able to check that the discussion list was highly used, showing the learners' interest to build knowledge together, but one specific material was barely used, indicating that or it is interesting enough or that it does not fit in the course process.

Agents will be used to collect these data during the learners' interaction with course materials and peers. They will be executing all the time, building an event database that will track all the interactions of every learner. The teacher will be able to see a chart, with graphical information, about the data collected by those agents.

This will help the teacher to make an evaluation of the course, and maybe to make a redesign of the course dynamics to fit the learning goals of the learners in future versions of the course.

B. Workflow-based Coordination

A learningware environment that supports constructivism principles allow active articulation in knowledge building through interaction and access to other individual and group knowledge structures and strategies [9]. However, intensive interaction may create some coordination troubles, such as, hyper-space disorientation, communication overload, task group disorientation, and lack of subgroup synchronism.

The Workflow Management Coalition describes workflow as the computerized facilitation or automation of a business process in whole or part [10]. Workflow can make big differences to the operational efficiency of processes. It can do this both by assisting in coordinating tasks and by providing information to help the group to perform a task [11].

Workflow technology aids the rationalization and explanation of action, facilitating cooperation. Nonetheless, its content interaction flow must be strictly obeyed. Thus, the use of workflow in learningware environments requires an adaptation of its structure. Reference [9] describes a model to apply workflow technology in learningware environments, introducing an adaptive structure to workflow, to accommodate a student-centered learning process.

The use of such mechanism will allow coordination of group tasks, checking the track of the learner interactions with the course materials and with other learners, which can be helpful to analyze the learner knowledge building process. It will also reduce the problems of hyper-space disorientation and communication overload.

C. Distributed Content Reuse

Since March 1998, more than 100 AulaNet servers were installed in all parts of the country, each one with its courses and contents. All these distributed servers created the necessity to reuse didactic materials that were published in different servers. Content reuse has been impeded by a lack of standards that would permit sharing across institutions and across a wide range of technical environments.

Today, the basic unit of the environment is a course. This high level unit complicates the reuse of specific material. To bypass this problem, AulaNet will be remodeled to incorporate the EDUCAUSE-IMS [12] standard. The IMS standard attempts to address three obstacles for providing effective online 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

This way, the content unit in AulaNet will be a material. A material is any atomic information within a course: a file, a discussion, an event in the agenda, etc. To allow reuse, the environment will start to catalog meta-data about a material. A meta-data is an information about an information (i.e. a material), which will help users to locate, evaluate, access and manipulate this information. The creation of meta-data is governed by schemes. A scheme is a logical structure generated by elements, according to specific rules that describe a particular set of values, which will be used to express the content of an information.

To reuse materials, two tools will be developed using the RDF/XML format [13] proposed by EDUCAUSE-IMS. The RDF model was designed to support the creation of communities of meta-data in the Web. The first tool will be responsible to create the meta-data information about a material. The second tool is a content search engine, which will be able to locate the several existing AulaNet servers and look for a specific material based on some meta-data.

Using the RDF/XML format to catalog meta-data about the contents of an AulaNet server, other AulaNet servers and other learning environments that catalog their contents according to the EDUCAUSE-IMS standard will be able to exchange materials, thus letting the creation of knowledge communities.

D. Simulation and Virtual Reality

Some aspects of the "real world" can never be experienced in a direct sense [1]. Simulation can be of educational value in these cases. As cooperative learning can be useful during simulation, it is possible to support cooperative simulation through MUD's (Multi-User Domains) and MOO's (MUD Object-Oriented) [1].

To provide a learner engagement with simulation, a parallel project named CLEW (Cooperative Learning Environment for the Web) [14] is under development at LES. CLEW combines the presentational format of the Internet with MUD's interaction style and the coordination mechanism associated to workflow management systems. The objective of CLEW is to create a cooperative platform of structured courses. Constructivism, learning metaphors and immersion shape the educational basis of the project.

The structure of CLEW follows the main aspects of MUD's which is to divide the environment into regions. A MUD is an environment based on the interaction between its

participants, providing access to a shared database of rooms, other objects and exits, thus creating a kind of virtual world.

The interactive aspects of MUD's allow the creation of a powerful cooperative environment; however, it lacks coordination. CLEW uses the characteristics of workflow to provide a way of coordinating this loose environment. The integration between WFMS (WorkFlow Management System) and MUD can provide the necessary means to define a stimulating and effective simulation learning environment.

The learner interacts with CLEW through a virtual reality interface, created using VRML (Virtual Reality Modeling Language). VRML provides a 3D interface, which is very common in video games. It gives an immersion sensation to the learner, who is stimulated to explore the environment, building his knowledge aided by visual memory. VRML also provides the facility to respond to several stimuli, simulating a game.

Currently, we could say that AulaNet's dominant metaphor is the digital library (content repository). In the future, when its concepts get together with CLEW's concepts, we can build an environment whose dominant metaphor would be the virtual laboratory (content manipulation).

E. Knowledge Communities

Much emphasis is being placed in modern school curricula on "learning to learn", as a response to the realization that, in the future, learning will be a lifelong occupation, largely occurring outside of the formal educational institution [15]. The concepts of work and learn will be mixed together. A typical person working in an organizational context will be required to participate in a process of continual learning and updating [16]. The 21st century will come out the knowledge-based organization and its principal employee, the "knowledge worker".

Thus, learning environments will become work tools. And these tools will allow active participants, with a great sort of competencies, to share experiences. There will be no more the static role of learner (information consumer) or teacher (information provider). There will be a democratization of access to knowledge allowing a participant to consume and provide information during the learning process.

AulaNet is seeking to be one of these tools that will be used by the knowledge worker. The EDUCAUSE-IMS standard provides innovative techniques for providing "librarian support" by automated means. Participants will be able to reach and use the knowledge inserted by any other participant using AulaNet.

The intended goal is not only to consume the knowledge materials inserted by other participants. A participant will be able to manipulate these materials, increasing its account of valuable information, thus enriching the material knowledge.

IV. SUMMARY

In this paper, we have briefly described the AulaNet environment, focusing its groupware approach guided by the trivet communication, coordination and cooperation. We showed how the teacher could combine the mechanisms, offered by the environment, to create the services that will be used by learners to build knowledge.

We have also showed some future development guidelines, including: the collection of course statistics, to help the teacher to evaluate his course; the creation of a flexible workflow structure for the course, so that the student will take advantage of a more structured knowledge creation; the development of librarian support, to make information widely

available, even in between different AulaNet servers; and, finally, the support of an engagement with simulation and immersion.

Since learning will become a lifelong activity, we intend to design an environment to allow experience sharing among knowledge workers, i. e. the future citizen, and thus creating knowledge communities.

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

Carlos J. P. de Lucena, lucena@inf.puc-rio.br; Hugo Fuks, hugo@inf.puc-rio.br; Ruy Milidiú, milidiu@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; Fabio Ferraz, ferraz@inf.puc-rio.br; Gustavo Robichez, guga@inf.puc-rio.br; Leandro Daflon, daflon@inf.puc-rio.br.

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