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Groupware Technologies for Education in AulaNet

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Abstract: This paper shows AulaNet—an environment for creation and maintenance of Web-based courses. This environment is based on three concepts: communication, coordination and cooperation. This paper also presentes some groupware technologies used in the environment and some future trends that will guide its development, focusing the creation of knowledge communities.

Keywords: groupware; web-based education; learningware; knowledge communities.

I. INTRODUCTION

Web-based education (WBE) 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]). Thus, 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. It is necessary to understand how established instruction systems (e.g., classrooms) can migrate to a more open organization.

This paper presents AulaNet, a groupware WBE environment with a cooperative approach. This paper also gives a description of the groupware technologies—used to allow participation tracking and content reuse—and of some future trends of the environment—that will allow student knowledge flow and 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 (e.g., [5]–[8]) because it is based on a groupware approach while most of the other related environments bring the traditional school physical metaphors: corridors, blackboards, general office, classrooms, library etc. We believe that this practice is a sub-utilization of the learning facilities provided by the Internet.

Based on the availability of tools tested by the LES, the following preliminary check-list was proposed: publication of the text book as hypertext; publication of texts associated to the lectures; transmitting and recording lectures with the instructor present; publication of students' projects; forms of assessing students (exams, etc.); interactivity on the Internet; form of online support to the organization of the course; students as information providers; and definition of development of the learning process.

II.A. Environment Actors

The current structure of AulaNet indicates that the teacher, the learner and the administrator are the actors involved in an educational process.

The administrator performs the day-by-day operational tasks of the environment—thus, facilitating the teacher/environment/learner integration—such as, learner enrollment and class creation. He is also responsible for the environment maintenance and for the environment interface definition.

The learner, now in an active position, represents the target of the AulaNet usage. It is important to remind him that reproducing the passive attitude he usually has in the traditional classroom will result in failure in this new environment. He must be stimulated to be active just like someone who uses the

Internet, plays games, or reads comic books. AulaNet offers new forms of communication that demand more interactivity (choice, participation and attention) than those of the traditional school.

The teacher is the actor who deserves special care. After decades of inflexible classroom teaching, he needs to understand the teaching process over the Internet—a process that comes along with new forms of communication and digital exchange spaces.

II.B. Content and Navigation

Breaking the wall of the traditional school and entering in the Internet requires creation of attractive didactic contents. The Internet demands a reformulation in the teaching process. Unfortunately, not all the teachers are prepared to create attractive and interactive contents because the Internet is a somewhat difficult programming platform: HTML, DHTML, CGI, JavaScript, Shockwave, and other words and acronyms are far beyond the knowledge domain of most of the common teachers. The solution proposed by AulaNet is the separation of the content authorship from the programming effort necessary to implement the content navigation—without which the content does not offer any interactivity.

While preparing a didactic content for AulaNet, a teacher may just use his old and well-known word processor to write a text, for example. The same is valid for the creation of slides, graphics, animations, etc. Later, using only a browser, he will upload the content for his course's workspace in the institutional AulaNet server. This way, he concentrates on his teaching subject, without having to make any code programming for Internet.

And about the problem of the Internet navigation? AulaNet transfers to the teacher the capacity to act as a designer of learningware. This learning groupware will support the cooperation that happens during the interactions of the learner with his instructor, with his peers, and with the didactic contents of the course.

II.C. Mechanisms and Services

Investigating the interaction dynamics of a cooperative group, it is possible to state that to cooperate, a group has to get coordinated and to get coordinated, a group has to communicate. By structuring into mechanisms the interactions related to the communication, the coordination and the cooperation of a

group, AulaNet helps the teacher to build his educational environment for the Web [9]. Therefore, 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 (an e-mail tool and a discussion list tool), an asynchronous text based conferencing tool (newsgroup facility) and a synchronous text based conferencing tool (chat).

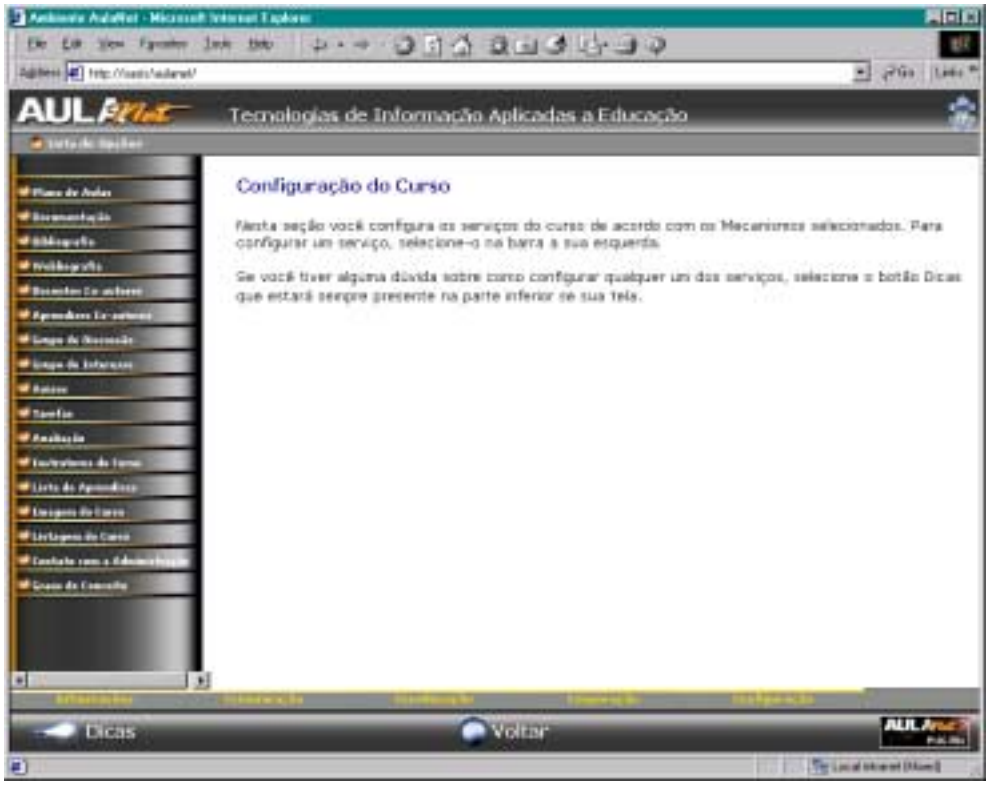

Figure 1: AulaNet Teacher Interface (in Portuguese)

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 [10].

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 preparing material for the learners' consumption and, 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.

The learner's empowerment is epitomized by the remote control. It offers a menu of services—high-level navigation facilities—tailored by the teacher's previous selection of the communication, coordination and cooperation mechanisms.

Figure 2: AulaNet Learner Interface (in Portuguese)

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. Other Groupware Technologies

There are two versions of the AulaNet environment: version 1.2 and version 2.0 beta. Up to date (February 2000), there were 1820 downloads of AulaNet 1.2 made – 80% of those made by educational institutions or government agencies and the other 20% made by corporate companies. AulaNet 1.2 is available for free download at <http://guiaaulanet.eduweb.com.br/english/indexi.htm>.

Besides the selection of communication, coordination and cooperation mechanisms, AulaNet 2.0—its newest beta release using Java Servlets [11] technology—uses some other groupware technologies described in the following sections.

III.A. Participation Tracking Reports

The generation of reports helps to track the learners' participation in the several events of the course and to check the quality of the contribution generated by this participation.

The teacher is able to stimulate the learners to actively participate in the course, and the learners enhance their awareness [12] on the environment. During the course flow, this awareness helps the learners to create a context for their work, using the contributions of the rest of the group as reference. This context is used to ensure that the contributions fit the group activities and the cooperative work process. The awareness also aids in leader identification and in the search for more skilled peers to perform some tasks of the group work.

Most of the events of a course are divided into categories to better stipulate the kind of contribution made. This categorization facilitates the "information aggregation" [13]. Information aggregation is a technique defined to reduce the volume of information and the communication overload. Aggregation, in this context, means that the information must be presented in an organized way. The participation reports show the contributions already categorized, helping both learners and teachers to check the course progress.

An interesting point for teachers is the possibility to assign marks to the contributions made by the learners. Statistics related to these marks assist the teacher in learner assessment. The absence of

contribution marks may indicate that the teacher is not following the learners efficiently, what can be a sign of teaching negligence. A "motivated" course, however, generates many activities and attributing marks concepts to a great amount of contributions can overload the teacher.

III.B. CONTENT EXCHANGE

To look for a specific item in the Web is similar to seek for a book in a disorganized environment. The amount of available resources in the Internet continues to grow exponentially, creating the necessity of gathering information about these resources. All those AulaNet servers downloaded have their own courses and contents, many of those addressing the same didactic subject. Thus, it would be desirable to offer a way to exchange and reuse contents that were published in different servers. However, content reuse has been impeded by a lack of standards that would permit sharing across institutions and a wide range of technical environments.

The IMS platform [14]—an academic, commercial and governmental consortium—is proposing and developing standards to allow content interchange between different Web-based education environments. The IMS standard attempts to address three obstacles to providing effective online materials and learning environments:

1. The lack of standards for locating and operating interactive platform-independent materials;
2. The lack of support for the collaborative and dynamic nature of learning;
3. The lack of incentives and structure to develop and share content.

The ContentNet [15] proposes an object-oriented framework to facilitate the description, the location and the reuse of available educational contents in servers compliant with the standards defined by the IMS platform. This framework intends to help users to locate, evaluate, access and manipulate the information stored in content servers that use meta-data. A meta-data is an information about a piece of information (e.g. a content), that is, "information about didactic contents that are available in the content servers".

The ContentNet works in the following way. First, the teacher describes the content he wants to reuse using some meta-data – type, origin, cost, size, for instance. Then, the search server consults the content

servers looking for similar meta-data. The content servers generate and send lists of meta-data to the search server. It is up to the teacher to select, amongst these lists of meta-data, the ones that come closer to the desired content. To finish, the search server recovers the content related to the meta-data the teacher selected in the corresponding content server.

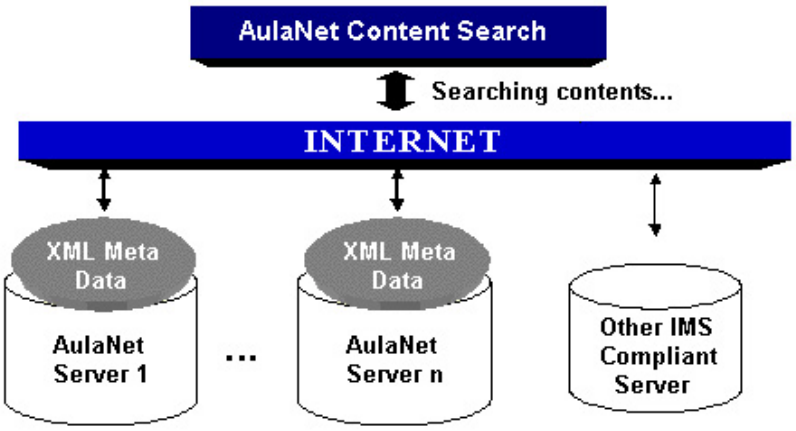

Figure 3: AulaNet Content Search Engine

IV. Some Future Trends

The AulaNet project is still growing, demanding for other groupware technologies. New AulaNet releases will address other groupware aspects such as workflow coordination and engaged cooperation. These aspects are described in the next sections.

IV.A. Workflow-based Coordination

A learningware environment that supports constructivism principles allows active articulation in knowledge building through interaction and access to other individual and group knowledge structures and strategies [16]. 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 [17]. Workflow can make a big difference to the operational

efficiency of processes. It can do this both by assisting in coordinating tasks and by providing information to help the group perform a task [18].

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 [16] describes a model for applying workflow technology in learningware environments, introducing an adaptive structure to workflow, to accommodate a student-centered learning process.

The use of such a 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.

IV.B. Engagement With Simulation and Virtual Reality

Some aspects of the "real world" can never be experienced in a direct sense [1] in a Web-based instructional environment. 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 learner engagement with simulation, a parallel project named CLEW (Cooperative Learning Environment for the Web) [19] is under development at the 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.

Figure 4: A Game in CLEW (in Portuguese)

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 will be able to build an environment whose dominant metaphor would be the virtual laboratory (content manipulation).

V. 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 [20]. The concepts of work and learning will be mixed together. An average person working in an organizational context will be required to participate in a process of continual learning and updating. The 21st century will see the emergence of the knowledge-based organization and its main employee, the "knowledge worker".

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

AulaNet aims to be one of these tools that will be used by the knowledge worker. The EDUCAUSE-IMS standard has 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 also be able to manipulate these materials, increasing its amount of valuable information, thus enriching the material knowledge.

VI. SUMMARY

In this paper, the AulaNet environment was described, focusing on its groupware approach guided by three concepts: communication, coordination and cooperation. It was also shown how the teacher could combine the mechanisms, offered by the environment, to create the services that will be used by learners to build knowledge in a groupware environment.

The common groupware technologies, such as e-mail, chat, discussion lists, co-edition are already addressed by AulaNet mechanisms since its first version. In its newest version, some other groupware

aspects such as awareness and content reuse were implemented. This paper also showed some future development guidelines including:

1. The creation of a flexible workflow structure for a course so that the student may take advantage of a more structured knowledge creation.
2. 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 to be shared among knowledge workers, i. e. the future citizen, and thus creating knowledge communities.

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