GROUPWARE TECHNOLOGY FOR COOPERATIVE LEARNING VIA THE INTERNET

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Abstract ¾ To take advantage of the numerous new resources for teaching/learning provided by the Internet, teachers should understand technologies that normally are not part of their fields. To get around this, they can use the AulaNet environment, which manages the learners' navigation through the educational content and offers integrated communication, coordination and cooperation services that can be used in the course. In this paper we report about how the AulaNet was configured and how its services aid in the creation and application of a course wholly taught through the Internet. We also show the methodology used as an attempt to get the students to learn on a cooperative basis, reporting the problems, the positive points and the results encountered during the six editions of the course.

Index Terms ¾ cooperative learning, distance learning, groupware, Web-based instruction.

INTRODUCTION

The rhythm of the production of knowledge and new telecommunication technologies are changing the way humanity lives and works [1]. Professionals dedicated to intellectualized work are in ever-greater demand. Besides having the knowledge necessary to do their jobs, workers also must acquire other, perhaps more important, skills [2]: know how to learn, so that they are able to adapt themselves to the constant evolution within the work environment; know how to work within a group, which is one of the aspects most required today by corporations; and know how to creatively change an old knowledge set into new knowledge, the most important element in modern institutions.

The changes in work patterns are also noticeable within the field of teaching [3]. In order to acquire the new skills demanded by the new work concept, education is undergoing a process of adaptation. The use of the Internet helps implementing cooperative learning [4], allowing for a rich exchange of information between members of a knowledge community.

Despite the fact that the Internet brings innumerable possibilities and facilities for teaching/learning, there are also many difficulties associated with it. For instance, if the institution does not provide support to Web content development for the teachers, they must learn technologies that normally are not part of their field of study, as for example *HTML*, *Java*, *XML*, *Flash*, etc. In order to get around this problem, they can use environments that separate content from navigation. This permits teachers to concern themselves with the production of educational content, using habitual tools such as word processing programs, while letting the management of the learners' navigation to the environment. Moreover, they can use the integrated communication, coordination and cooperation services of the environment in order to supplement the course.

It was with this scenario in mind that the Information Technologies Applied to Education (ITAE) course was designed and is being applied. Its purpose is to get students to learn to work with information technology as a group, turning them into Web-based educators [5]. The class has been conducted since 1998 as a regular course and currently is wholly taught on the Internet through the AulaNet environment [3].

In this paper we will report on the methodology that was used, the results that have been obtained and the difficulties that have been encountered in the development, application and integration of the course with the environment.

THE ITAE DYNAMIC ON THE AULANET ENVIRONMENT

The AulaNet is an environment based upon a groupware approach for the creation, delivery and administration of Web-based courses. Its development has been carried out since June 1997 by the Catholic University of Rio de Janeiro. This groupware approach has a fundamental role in the ITAE course, since the cooperation between the learners in a group is also important as the individual study of the content of the course [6].

In AulaNet courses we can have mainly two different roles for teachers: the coordinator and the instructor. The coordinator's role is to design the course, defining and configuring the content and the services that are made available to learners. The instructor is the person who animates the group, maintaining order, motivating and evaluating learner participation.

The thinking that guided the design of the AulaNet and the ITAE is that for group learning an individual must share ideas (or communicate), be in tune with the other participants of the groups (coordinate), and carry out tasks in a satisfactory manner (cooperate) [7], as we can see in

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Figure 1 [8]. The group work realizes mainly through the communication, which interconnects the group in order to have the coordination and show the results of the cooperation. All the communication, coordination and cooperation generate events that are perceived by the participants, and can cause information overload [9]. All AulaNet services are organized based upon these concepts.
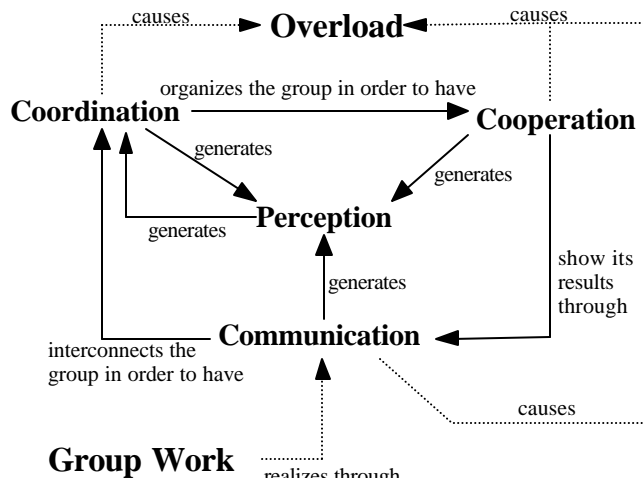

FIGURE 1
MODELLING GROUP WORK

The services are placed at the disposal of coordinators during the creation and updating of a course, permitting them to select those that they want to make available to the learners and configuring them within the course's workspace. In ITAE, the services are added to the course as it unfolds in order to smooth the absorption of the environment by the learners.

Communication services

The communication services provide the facilities that permit the exchange and sending of information [10]. These services include tools for individual electronic mail exchange with the instructor (Contact with the Teachers), with the entire group (Discussion Group), an asynchronous text discussion tool in a forum style (Interest Group), a synchronous text conference tool as a *chat* (Debate) and a tool for the instantaneous exchange of messages with participants who are connected to the course (Contact with the Participants). Since ITAE is a course that is based mainly on participant interaction, it uses all of the communications services.

The 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 instructors or coordinators, depending upon the choice of the learner, and are kept available in the environment for subsequent consultation. The ITAE's students use this service to resolve operational doubts and to make comments or complaints. When the subject of the message is of interest to the entire group, the learner is asked to use the Discussion Group or Interest Group services.

The Discussion Group service acts like a mailing list and is used to communicate with the entire group. When a message is posted on this service, besides being filed within the environment it is sent to the electronic mailbox of all participants. 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. This service was used for the discussion of the course content and for coordination messages from the instructors.

The Interest Group is a conferencing system where it is possible to reply the messages, in order to answer, comment, criticize or whatever else. The replies are showed indented below their related messages, forming a threaded discussion. This structure permits the organization by topics, with related messages remaining compartmentalized below the original topic message. In the ITAE, the Interest Group service is used to develop course themes, and topics selected by the group, in depth.

The Debate service is a real-time conversation through text chat. In the ITAE, the topics are divided into classes and the Debate is used for weekly discussions. Since it is a synchronous communication tool, before beginning the course the learners are informed about the time slot that should be reserved for the debate.

Finally, the Participant Contact service lets members of the group who are connected to the environment at the same time contact each other through messages that open up in new windows. In ITAE it does not have a specific purpose, but the participants use it to communicate individually during a debate, to request information or only to greet each other.

Coordination services

The coordination services provide the means for managing the group's agenda and competence. These services include a notification tool (Notices), a tool for the basic coordination of the flow of the course work (Lesson Plan), assessment tools (Tasks and Exams) and a tool for monitoring group participation (Follow-Up Reports). The ITAE course uses the following coordination services: Lesson Plan, Tasks and Participation Reports.

The Tasks service is used to assign work to learners. The AulaNet manages task resolution file submissions and lets the instructor make assessments and comments. In the ITAE, this service is used to assign monographs at the end of the course. The environment permits configuring if a learner's task resolution is visible to the others. This is allowed in the ITAE, since the monograph themes are all different and having access to the work produced by colleagues motivates the learners who know that members of their group will be seeing their work [11]. It also brings more examples for those who are still developing their own topics.

Instructors use Lesson Plan to structure the course's educational materials, separating them into classes. These classes follow an order that is suggested, but not imposed, indicating a basic flow for the course. In the ITAE the lesson content is made up basically of video, slide presentations and supplementary texts that learners may consult at any time. The environment allows learners to take private notes on a class that remain on file for their personal viewing.

The Follow-Up Reports make the quantifying and qualifying of learner participation possible. The teacher chooses the interval of the grades and their corresponding concepts for asynchronous and for synchronous events. In ITAE the concepts used are good, regular, weak and very bad for asynchronous events and very active, active, low active and indifferent for synchronous ones. These concepts correspond to grades from 0 to 10, in intervals of 2.5. The instructor assign concepts for the messages of the Discussion Group and of the Interest Group, that are asynchronous, and for the participation in the Debate, which is synchronous. The AulaNet offers reports about average concept of the learners, effective contributions, frequency of participation in debates, quantity of contributions per service and detailed information of each service.

Cooperation services

The cooperation services provide the means for cooperative learning [12], problems resolving and course co-authorship, both for teachers (Teacher Co-Authorship) as well as for learners (Learner Co-Authorship). The cooperative services also include a list of extra contents that are not associated with any specific lesson (Documentation), references to textbooks (Bibliography) and Internet pages (Webliography). The ITAE uses Bibliography, Webliography, Documentation and Learner Co-Authorship cooperation services.

The Bibliography, Webliography and Documentation services are other means through which the teacher can present educational materials to the learners. The Bibliography is composed of references to textbooks that can be used as support material for the course. The Webliography is made up of references to Internet pages that are outside the environment. The Documentation is comprised of content that is not associated with any class and that serves as extra course material. The Learner Construction-Authoring Service is used to permit learners to supply new content to the course. The teacher needs to check up on the content generated by the learner in order to incorporate it into the course.

COURSE'S CONSTRUCTION AND REFINING

The ITAE course covers the following topics: groupware concepts, digital communication, Web-based instruction (WBI), learningware, interactive multimedia, learning environments, education in the Internet 2 project and knowledge communities. The objective of the course is to capacitate educators to use the new technologies for teaching/learning and to develop a community of persons who are interested in the subject.

Preparation of the content

The course was taught for the first time during the first half of 1998. Initially the course structure included a weekly class and a debate via the Internet, using the AulaNet's Debate service. This embryonic version of the ITAE served to generate educational content for the course, which was produced by recording the presentations given by the teachers during the weekly classes and by copying the transcripts of the chat sessions. As they were generated, this content was made available within the environment and learners could access it at any time and from any computer connected to the Internet.

Every course edition takes advantage, with some adaptation, of the content produced in the previous ones. In some editions, the learner's final task was to prepare a new class or monograph about a theme discussed in the course, helping the generation of the content. These demonstrate the evolutionary aspect of the generation of a community—that is, the passing along of an existing culture and evolution for new participants.

At about the fifth edition the learners began to complain that some of the course content was out of date, mainly some parts of the videos recorded in the first edition. Also various references made to Internet pages in slide presentations were no longer valid.

Group organization

In the second edition, besides the regularly enrolled students, outside individuals were allowed to participate in the course, totalizing more than 100 learners. The excessive number of participants made it difficult to prepare a cooperative learning process that could count upon everyone's participation. Hundreds of messages were posted weekly in the Discussion Group service making arduous the task of reading them all before the debate. To solve this communication overload problem [9], from the third edition on, the learners have been separated into smaller subgroups of no more than 25 participants, each with its own instructor.

In general, it was noted that the students who were enrolled in the course and who consequently would be graded according to their work participated more than the others. The presence of "tourist" students, who entered the environment on an occasional basis, inhibited some participants. The lack of a grade or a payment that served as a commitment for participation can bring unexpected effects in terms of the lack of interaction [13,14,16].

Participant Motivation

To encourage the learners' involvement with the course, each of them was designated as seminar leader for one or more of the weekly topics. This person was responsible for carrying out research into the discussion topic and preparing

the Seminar, consisting of a message presenting his or her point of view about the theme. Each of the other learners prepared their own contributions for the Seminar, delving into greater depth about an aspect of the topic. Another function of the seminar leader was to coordinate and animate the Debate together with the instructor, encouraging learner participation, proposing topics and maintaining the focus of the discussion. Since one of the objectives of the ITAE is to capacitate instructors to teach courses via the Internet, nothing could be better than to learn by doing.

To break the inertia and initial fear of the participants, bringing them closer together as a group, since the fifth edition of the course the learners have been asked to present themselves to the group during the first week. They are asked to discuss why they are taking the course, their name and occupation, their expectations and previous experience with the subject matter.

In order to help learners understand how things should be done, the first seminar leader is assigned to an instructor and the topic is "Introduction to the AulaNet Environment and the ITAE course." During this seminar the environment services and the methodology is presented as well as the behavior that is expected from the participants. And the learners have the opportunity to make free use of the environment.

Message Categorizing and Structuring

Seeking a better organization of the large volume of messages, message categorizing was implemented on the AulaNet. The coordinator chooses desired categories and, upon sending a message, the participants have to select the one that most reflects their intention. In the fifth edition of the course, the first time this feature was available, the following categories were chosen for the Discussion Group: **Presentation**, for the participant's self presentation; **Seminar** and **Contribution about the Seminar**, for messages from the seminar leaders and contributions to them; **Operational Problems**, to report problems; **Question**, **Position** and **Argumentation**, for discussion of topics through questions, answers and explanations; and **Generic**, for messages that did not fit into any other. The use of categories made the messages more organized, also making it possible for participants to identify the content of the messages much more quickly.

In the fifth edition of the course and before, the discussion of the seminars and the coordination messages from the instructor were posted in the Discussion Group. Since these two types of messages were showed in a chronologically ordered list, the messages were intermingled, making the list disorganized.

In the sixth edition of the course, as an effort to solve this problem, the discussions about course content were transferred to the Interest Group service. A new forum was created for each class and the messages were organized and compartmentalized there. The Group Discussion service was basically left for group coordination.

The categories **Presentation**, **Operational Problems** and **Generic** were maintained in the Discussion Group service. In order to reduce the number of generic messages, which corresponded to 35% of the messages of the previous semester and were used basically for coordination messages from the instructor, the **Notice** category was created for notices, **Monograph** for messages related to the final work and **Evaluation** for the learners to evaluate the course.

The categorizing of messages was also adopted for the Interest Group service. The categories **Seminar**, **Contribution about the Seminar** and **Question** were transferred from the Discussion Group. The categories **Position** and **Argumentation** were condensed into a new category named **Argumentation** and a **Counter Argumentation** category was created for messages that oppose arguments. Finally there were the **Doubt,** for questions that do not generate debate, **Clarification,** to resolve doubts and misunderstandings, **Case,** for exemplification and **Generic,** for messages that do not fit into any other category. The number of messages for each category and a comparison with the previous semester can be seen in Table I, where DG means Discussion Group, IG is Interest Group and the number in parenthesis is the category's quantity of messages. Both the editions had approximately the same number of participants, in average 9 participants.

TABLE I
COMPARISON OF THE CATEGORIES USE

Fifth Edition	Sixth Edition
DG: Seminar (18)	*IG: Seminar (13)*
DG: Seminar Contrib. (75)	*IG: Seminar Contrib. (33)*
DG: Presentation (9)	DG - Presentation (12)
DG: Operational Prob. (12)	DG: Operational Prob. (14)
DG: Question (11)	*IG: Question (65)*
DG: Position (6)	*IG: Argument (129)*
DG: Argument (2)	*IG: Counter Argument (26)*
DG: Generic (72)	DG: Generic (20)
IG: Generic (90)	*IG: Generic (12)*
	IG: Doubt (7)
	IG: Clarification (25)
	IG: Case (2)
	DG: Assessment (18)
	DG: Notice (50)
	DG: Monograph (20)
Total: 288	Total: 446

The change of topics from the Discussion Group to the Interest Group made it possible to increase the discussion about the course's subjects, raising the average number of messages per seminar from 7 to 24. The quantity of messages that were posted in the Question, Argument and Counter Argument categories in the sixth edition (220 messages) was 11 times greater than the quantity of messages in the Question, Position and Argument categories

the fifth edition (79 messages). The Case category was practically not used and there was a significant decline in the quantity of Generic messages in the Group Discussion (72 to 20) with the adoption of the Notice category.

Evaluation of the learning process

Evaluation of learners in the ITAE is based on their participation and the quality of their contributions [13]. Although the AulaNet contains evaluation services in the form of exams with questions, the ITAE did not make use of this service in order to evaluate learners based upon cooperative rather than individual tasks. To help the teacher to accompany the students and to make it possible for the learners to evaluate their own level and quality of participation [15], follow-up reports of the environment were used to present information about the quality, the quantity and type of participation. As the quality information cannot be extracted automatically, the participation has to be evaluated by the instructor. He has to grade individual participation in the debates and the messages in the Discussion Group and in the Interest Group.

The message evaluation provided feedback to the learners regarding their contributions as well as a point of reference for other learners. Knowing they were being evaluated, the learners worked hard to obtain good grades in their messages, which led to an improvement in the quality of the contributions in comparison to the previous editions when the evaluation had not yet been adopted. Despite this positive effect, the learners complained about lack of knowledge of the judging criteria, the lack of teacher comments about positive and negative aspects of the work, and the possible inhibition of learners to send in contributions, knowing they were being graded.

Evaluation in the ITAE sought to involve the learners in a group process [16], however to make an evaluation that is based upon contributions is an arduous task. The teacher must constantly keep up with the group in order to be able to verify the quality of the contributions.

ANALYSIS OF THE ITAE COURSE

Now let's look at some of the observations and conclusions that were obtained from the six editions of the course and that may be useful in order to prepare and perfect distance-learning courses on the Internet.

Cost of development, updating and delivery

In principle, the time and effort needed to develop good educational content were substantial and possibly prohibitive. In order to develop attractive content, besides understanding of the subject matter, other skills are required, such as graphic design techniques, which the teacher generally does not possess. The ideal situation is for the teacher to have the support of a team that has such skills. Nevertheless, a team of this type requires a high level of financial resources. Since the ITAE does not have such resources, it was developed over time and a large portion of its educational contents was re-used and added to it with the help of the learners.

Regarding the updating of the content, the major obstacle that was encountered was the difficulty in editing video due to the complexity of modifying only part of a speech without having to re-record it. Media such as text and slide presentations do not present this type of problem. External Internet page references also generated problems, because links change frequently forcing the instructor to constantly check all references.

The cost of monitoring the learning process [17], moreover, uses up a lot of the instructor's time, who must accompany, assess and motivate the learners and answer their doubts, which are usually in greater volume than in live teaching because of the relative ease of sending a query.

Communication Tools

The Discussion Group, which is based on a mailing list, is suitable for notices, discussion about the course and other coordination messages. The Interest Group is suitable for the course's topic of discussion since it makes it possible to organize the messages into topics as well as structure the argumentation. As for the Discussion Group, it is an asynchronous communication tool where the participants have more time to prepare their messages, which therefore are usually more elaborated and complete than the ones from the synchronous services such as Debate.

During the debate, given that the time to answer questions is limited, in general the contributions are short, not well elaborated and full of abbreviations and typing mistakes that are tolerated as long as they do not distort meaning. As a participant writes a message while other messages are being written and sent, the topics intermingle and are easily changed, making it difficult to discuss any single topic in depth. Despite its difficulties, the Debate generates a sensation of proximity between learners and instructors and the discussion of the topics take unexpected directions that are only possible to obtain through the collaboration of the group, thus generating new questions and ideas.

Learner participation

With few exceptions, the participation of the learners during the course has been satisfactory. But there are times when the level of interaction begins to decline, requiring the intervention of the instructor, who needs to send out motivational messages to individuals or to the group. Other factors that harm the level of participation are the difficulty of using the environment and the inhibition of learners who are afraid of exposing themselves. The instructor must maintain order and evaluate and correct missteps, but also must take care that these attitudes do not inhibit learner participation.

Group size and overload

The first classes in the course, with over 100 learners, were not satisfactory in terms of interaction. In order to monitor the progress of individual learners and to maintain order in the communication services, we currently understand that the number of learners per group should not surpass 25, and when the participants are particularly active, this number should be around 15.

Evaluation of the course by the learners

Upon a request of the instructors, some students from the lasts edition of the ITAE evaluated the course, speaking freely about their points of view. The learners reported that despite the sensation of freedom and the facilities provided by education through the Internet, the responsibility, the level of participation, the commitment and the time dedicated to the course were greater than they had imagined. In general, they liked the variety of content formats: videos, text and slide presentations, which allowed the choice of form that most pleased them [18]. They complained that there were an insufficient number of Internet references, but it made them search for new ones bringing new and update content to the course. Although they liked the content, the learners affirmed that the learning process occurred mainly during the exchange of points of view and experiences with other learners.

The learners also stated that the heterogeneous set of activities (seminars, contributions, debates, interest groups, monographs, etc.) permitted a major involvement and allowed the assimilation of the content in a constructive manner. It also was reported that the obligation on the part of learners of preparing a seminar and contributions to the seminars contributed to both individual and group learning.

All of the learners who evaluated the AulaNet were positive about it. They emphasized that it really helped the learning process due to the variety of services and the simplicity of its use, even for those who do not come from the field of information technology.

CONCLUSION

The ITAE was developed for Web-based delivery. The cost of developing, in principle, was significant, but it declined over time as a result of the re-use of the content. The group of learners had to be limited in order to create a sense of community, to make their participation possible and to satisfactorily accompany them.

The Internet can offer the learning process a variety of benefits, including easy access to educational content, interaction, cooperative learning process and re-use of content. Environments such as the AulaNet provide the means to facilitate the online learning process. As described in the model of Figure 1, the group work take place more as a result of communication among the participants than through the individual study of the course's contents. The communication also interconnected the group and made it possible to coordinate the activities, mainly by the instructors, in order to organize the participants and make the cooperation possible.

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