Using the AulaNet Learning Environment to Implement Collaborative Learning via Internet

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The AulaNet environment was developed in a way to allow teachers to concentrate mainly on producing content while the environment help to manage learner navigation. Furthermore, AulaNet offers integrated communication, coordination and cooperation services that can be added to courses in order to supplement them. One of the courses that is being taught via Internet through AulaNet at PUC-Rio is called Information Technology Applied to Education (ITAE), which is taught completely online. This paper explains how AulaNet was configured and how its services helped in the creation and application of the ITAE course during the period 1998 to 2002.

1. INTRODUCTION

The manner in which people work has changed with the advent of the connected society. Accustomed to the paradigm of command and control that is taught—or, rather, conditioned—in the classroom and widely disseminated on the factory floor, workers are not always prepared for the new demands of the information society. Workers are taught to react to clear orders, well-defined procedures and specific activities of individual preference. Their understanding of communication is vertical (memorandums that come down from above and reports that are sent up from below). Therefore, as in the classroom, horizontal communication—communication with a shift colleague—besides not being well thought out is also given no technological support.

However, in most cases, knowledge workers are capable of working in groups and learning new processes and techniques on a continuous basis in order to carry out their tasks. Knowledge workers constantly interact with their colleagues in the search for information that is relevant to carrying out the tasks that are imposed by the connected society. Due to the complexity and interdisciplinary aspect of these tasks, knowledge workers and their colleagues join together to resolve the problems that emerge on a day-to-day basis. The organization that was imposed from the top down in the command and control paradigm loses effectiveness and is substituted by one that is less hierarchical and more participatory, where communication, coordination and cooperation predominate.

Working in groups generates various characteristics such as: synergy; the ability to consider more information; objective evaluation; cognitive stimulation and a process whereby members learn from one another [1], all of which enhance the work environment and learning. The use of Internet to implement collaborative learning offers a number of resources which facilitate group interaction and the presentation of content and minimize temporal and geographical barriers [2].

Although Internet offers advantages and facilities for teaching/learning, there are also many difficulties associated with its use. To produce interactive Web-based content, for instance, if an institution does not

provide support for it, teachers must comprehend technologies that sometimes are not part of their expertise. To reduce these difficulties they can use environments, like AulaNet, that separate content from navigation. This lets them concentrate on the production of content, using habitual tools such as word processing programs, while leaving the management of learner navigation to the environment. Additionally, integrated communication, coordination and cooperation services can be added to courses, and some environments supply reports so that teachers can follow up learner participation.

It was with this scenario in mind that the Information Technologies Applied to Education (ITAE) course was designed. The aim of the course is to get students to learn to work in groups with information technology, turning them into Web-based educators. It is a regular subject offered at PUC-Rio to post-graduate and Computer Engineering students. The class has been conducted since 1998 and is taught wholly on Internet through AulaNet. AulaNet is a learning environment that was developed based on a groupware approach, for helping teachers in the task of implementing collaborative learning via Internet. It supports "anytime/anywhere" interaction among the group and manages learner navigation through content. The AulaNet server is freeware and can be downloaded from http://guiaaulanet.eduweb.com.br. The users have access to it by them web-browsers.

This paper presents the results obtained and the difficulties encountered in the development, application and integration of the course within the groupware environment. In Section 2, a collaboration model that guided the development of the AulaNet environment and ITAE course is presented. In Section 3, the AulaNet services are presented, detailing how they were used in the ITAE course. Section 4 discusses integration of the course into the environment and its application. Finally, Section 5 concludes the paper.

2. THE COLLABORATION MODEL

Potentially, at least, collaboration can produce better results than individual work. A complementing of skills and individual efforts occurs in a group. By collaborating, members of a group receive feedback that early on permits them to identify inconsistencies and communication breakdowns in thinking processes and, together, they can seek ideas, information and resources to resolve the problems.

The contribution of different understanding or the exposure to alternative points of view can enhance learning [3]. Group members can monitor individual thinking and the group structure provides social support and encouragement for individual effort [1]. Groups are able to pool more ideas and information from different sources and are more creative at generating options and probing their advantages and disadvantages than are single individuals [4]. Also, through formulating ideas in their words, and receiving evaluation from peers, students' knowledge, thinking skills and meanings are socially constructed [2].

In order to be successful, collaboration requires additional effort to coordinate the members of a group. Without such coordination, much of the communication effort will not be taken advantage of during cooperation. That is, in order for the members of a group to be able to operate together in a satisfactory manner it is necessary that commitments assumed in participant interaction be carried out during joint work in a shared space. Coordination also deals with conflicts that may harm cooperation in the group. The diagram shown in Figure 1 summarizes these main concepts.
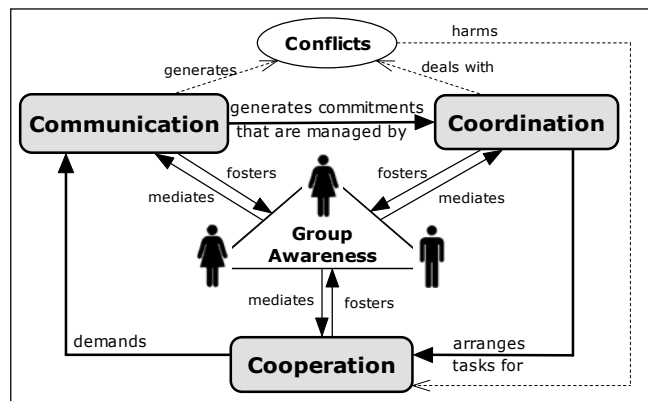

FIGURE 1. THE COLLABORATION MODEL

The AulaNet environment and the ITAE course were developed with this model in mind. In AulaNet, all services are organized into three main types: communication; coordination and cooperation. The next section presents AulaNet and how it was used for the ITAE course.

3. THE ITAE COURSE IN THE AULANET ENVIRONMENT

AulaNet is a freeware environment based upon a groupware approach for teaching and learning on the Web. It was created in 1997, and has grown and developed since then with the help of doctorate, master's degree and undergraduate students, who maintain it and improve it with topics from their research. A comparison with other environments can be found at [5].

In AulaNet courses, teachers can have three different roles, which may or may not be assumed by the same person. The coordinator's role is to design the course, defining and configuring the services that are made available to learners. The author's role is to produce and insert content. The mediator's role is to animate the group, maintaining order, motivating and evaluating learner participation. In the ITAE course there are two coordinators who also assume the author's role, and there are mediators, who vary from one semester to the next.

FIGURE 2. THE AULANET INTERFACE

The AulaNet services are placed at the disposal of coordinators during the creation and maintenance of a course, enabling them to select those they wish to make available to learners in the menu represented as a remote control unit (Figure 2). During the ITAE course, the teacher gradually makes more AulaNet services available to help the learners understand the environment in which they are studying.

3.1. Communication Services

Contact with the Teachers is a channel for students to contact the teaching staff. Messages are sent through electronic mail to the mediator or coordinator, depending upon the learner's choice, and remain available in the environment for subsequent consultation. 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 mediator asks the learner to post it on the **Discussion List** or **Conference** service.

The **Discussion List** acts like a mailing list and is used to communicate with the entire group through textual messages. When a message is posted on this service, besides being filed within the environment it also is sent to the electronic mailbox of all participants. Consequently, everybody is aware of the activities on the **Discussion List**, even if they do not enter the environment. In AulaNet, the messages are shown as a chronologically sorted list. In the course this service is used by the mediator to send coordination messages to the group.

Conference is a conferencing system where it is possible to reply to messages, make comments, suggestions or otherwise. The replies appear indented underneath their related messages, forming a threaded discussion. This structure permits organization by topics, with related messages below the original topic message. The **Conference** service is used on the course to develop in-depth course themes and topics selected by the group.

The **Debate** service is a real-time conversation through textual chat. In the ITAE course, 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 learners are informed about the time slots that should be reserved for debates.

Finally, **Messages for Participants** enables members who are simultaneously connected to the environment to contact each other through messages that open up in new windows. Participants on the ITAE course use this service to communicate individually during a debate, to request information or even just to greet each other.

AulaNet implements message categorizing in the **Discussion List** and in the **Conferences** service. Message categorizing helps organize large volumes of messages, reducing information overload on the participants [6]. The coordinator chooses the desired categories and, upon sending a message, participants have to select the one that most reflects their intention (as can be seen in Figure 3). Once they have been categorized, the messages can be put into groups and reports can be produced giving details of how the discussion is progressing and the different types of learner contribution.
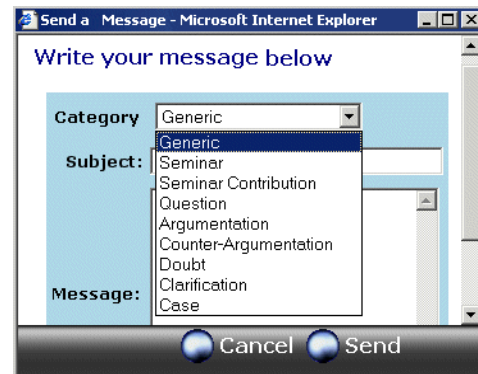

FIGURE 3. CATEGORY SELECTION

The course coordinator chose the following categories for the **Discussion List**: *Presentation* for the participant's self presentation; *Notice* for notices; *Alert* for messages about deadlines, debts and incentives; *Question* and *Answers* to resolve doubts about course methodology or conduct opinion surveys or elections; *Operational Problems* to report problems; and *Generic*, for messages that did not fit into any other category. In **Conferences** the following categories were chosen: *Seminar* for the message that starts the discussion; Question, Argumentation and Counter-Argumentation for discussion (these categories are based on the IBIS – Issue Based Information Systems – argumentation model [7]); *Clarification*, to solve doubts and misunderstandings; and *Generic* for messages that did not fit into any other category.

3.2. Coordination Services

The **Tasks** service is used to assign work to learners. The AulaNet manages task resolution file submissions and lets the mediators make assessments and comments. This service is used to assign a task at the end of the course. To resolve this task the learners have to collaboratively produce interactive multimedia digital education content for the course. The coordinator selects content that is good for inserting into the course, so that subsequent groups can take advantage of it (authorship for the new content is credited to the original authors), as will be detailed in section 4.5. The environment also allows configuring so that a learner's task resolution is visible to the others of the same group. This is allowed in the ITAE since the tasks 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 viewing their work [8]

The **Lesson Plan** is where the coordinator structures the educational content, separating it into classes. The learners can access any content at any time during the period the course is being taught. The ITAE lesson content is made up of video, slide presentations and supplementary texts. AulaNet also allows learners to take private notes about a class that remains on file for their personal viewing, allowing them to save doubts, observations, comments, pending tasks, etc. for each examined content. An instructional designer can use the Lesson Plan service to select and structure the contents of the course.

The **Follow-Up Reports** make it possible to quantify and qualify learner participation. The teacher chooses the grade intervals and their corresponding concepts for asynchronous and synchronous events. AulaNet offers reports about the average concept of the learners, effective contributions, frequency of participation in debates, quantity of contributions per service, use of categories and detailed information of each service.

3.3. Cooperation Services

The cooperation services provide the means for cooperative learning [2], problem resolution and course co-authorship, both for teachers (**Teacher Co-Authorship**) and learners (**Learner Co-Authorship**). The cooperative services also include a list of extra content topics that are not associated with any specific lesson (**Documentation**), and references to textbooks (**Bibliography**) and Internet pages (**Webliography**). The ITAE uses **Bibliography**, **Webliography**, **Documentation** and **Learner Co-Authorship** cooperation services. The **Learner Co-Authorship** service is used to permit learners to supply new content to the course, which is validated by the coordinator.

4. CONSTRUCTION AND REFINEMENT OF THE COURSE

The use of the AulaNet environment does not presuppose the use of any specific methodology. The environment can be used to supplement traditional classroom, although originally it was designed to support collaborative learning. The ITAE, which exemplifies this use, has been taught since 1998 as one of the courses of the Computer Science Department of PUC-Rio and is entirely taught via Internet within the AulaNet environment. The objective of the ITAE course is to foster educators to use the new technologies available for teaching/learning. The course syllabus comprises topics such groupware concepts, digital communication, Web-based instruction (IBW), learningware, interactive multimedia, learning environments, implementation of IBW and knowledge communities. Each of these topics is discussed in specifics sessions using the AulaNet services Conferences and Debate.

4.1. Educational Content

In order to develop attractive content, besides understanding the subject matter, other skills are normally required such as instructional and graphic design skills and Web programming, which sometimes teachers do not possess. The ideal situation is for a teacher to have the support of a team that has these skills. Nevertheless, a team of this type requires a high level of financial resources. Since the ITAE course did not have such resources, it was developed over a period of time and a large proportion of its educational content was re-used and added to with the help of the learners.

At the beginning, the course structure included a weekly, live face-to-face class that was transmitted to outside students, and a debate via Internet, using AulaNet's *Debate* service. This embryonic version of the ITAE course served to generate educational content, which was produced by recording the teachers' presentations during the weekly classes and by copying the transcripts of the chat sessions. As it was generated, the content was made available within the environment and learners could access it at any time and from any computer connected to Internet.

Each subsequent edition of the course, with some adaptation, took advantage of the content produced in previous ones. The learner's final task of preparing new educational content about a theme that had been discussed in the course helped to generate new content. This demonstrates the evolutionary aspect of the generation of a community—that is, the passing along of an existing culture and evolution to new participants.

Commencing around the fifth edition, learners began to complain that some of the course content was out of date, mainly some parts of videos recorded during the first edition. In addition, various references made to Internet pages in slide presentations were no longer valid. The major obstacle that was encountered in updating the content 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 teacher to constantly check all references.

Moreover, the idea is that the course should supply only some initial references and the learners must find others in order to prepare their contributions. As a result, the references consulted by each learner, in general, are different from those found by others, and bring new information to the group. In addition, it is

part of the course to train learners to find their own source of information on the Web, because this action is of fundamental importance for Web-based educators.

Although they liked the content, learners affirmed while evaluating the course that the learning process occurred mainly during the exchange of points of view and experiences with other learners. In this evaluation, some learners, who were new to the field of information technology, complained about the excessive use of technical terms and suggested that a course glossary be created.

4.2. Evaluation of the Learning Process

Evaluation of learners on the ITAE course is based on their participation and the quality of their contribution [9]. Although AulaNet contains an evaluation service in the form of exams with questions, the ITAE course does not use this service to evaluate learners based upon collaborative rather than individual tasks. To help the teacher accompany the students and to make it possible for learners to evaluate their own level and quality of participation, follow-up reports generated by AulaNet were used to present information about the quantity, quality and type of participation [10], as can be seen in the Average Grade Report shown in Figure 4. To supply qualitative information, each participation has to be evaluated by the mediators, who need to grade and comment individual participation in the **Debate** and the messages in the **Conferences** service. The **Discussion List** messages are not evaluated, as they are not part of the tasks assigned to learners.

The message evaluation provided feedback to the authors regarding their contribution as well as a point of reference for other learners. Knowing they were being evaluated, the learners worked hard to obtain good grades for their messages, which led to an improvement in the quality of the contributions in comparison to previous editions, when the evaluation system had not yet been adopted. Despite this positive effect, some learners complained about a lack of knowledge of the judging criteria and a possible inhibition of learners to send in contributions, knowing they were being graded. Most of the learners recognized that message evaluation was useful, encouraging them to participate in a more and better fashion, and they regularly checked the reports to see their progress and to compare their own participation against that of their colleagues.

Participants	Conferences 8 (6)	Debate 8.08 (4)	Average Concept 8.63 (10)
Adriana	Good / 9.82	Very active / 9.5	9.69
Gustavo	Regular / 7.12	Very active / 9	7.48
Hiran	Regular / 7.61	Very active / 8	8.37
Judith	Good / 9.5	Very active / 9.5	9.5
Leonel	Good / 9.29	Active / 6.88	8.32
Márcio	Regular / 7.75	Very active / 9	8.85
Mariano	Good / 10	Very active / 9.38	9.75
Pedro	Good / 9	Very active / 9	9
Renata	Good / 9.24	Very active / 9	9.15
Rodrigo	Regular / 7	Low active / 3.33	7.33
Weight	6	4	10

FIGURE 4. FOLLOW-UP REPORT

However, monitoring the learning process uses up a lot of a teacher's time [11]. The mediators must accompany, assess and motivate the learners and answer their doubts. They must constantly monitor the interaction in order to maintain order and netiquette, and give timely feedback to the group, avoiding anxiety and frustration. Since more than 800 messages are sent to the course during each semester, evaluation becomes an arduous task.

4.3. Participant Introduction to the Course

Since the fifth edition of the course, during the first week participants have been asked to introduce themselves to bring them closer together as a group and to discourage them from feeling inhibited in any way. They are supposed to explain why they are taking the course, give their names and occupations, their expectations, and describe their previous experience with the subject matter.

In order to help learners understand how things should be done, the first class assigned to a mediator is always "Introduction to the AulaNet Environment and the ITAE course." During this class, the AulaNet services and the ITAE course methodology are explained as well as the behavior that is expected from the participants, and the learners have the opportunity to make free use of the environment, without being evaluated.

4.4. Content Discussion

As the objective of the ITAE course is to train educators, the reversal of roles between teachers and learners is encouraged. Thus, two special roles were created for the learners: Conference leader and Debate moderator. The learners take turns in these roles each week during the run of the course topics. The conference leader is responsible for initiating the discussion through a message sent out on the Seminar category. In this message, the conference leader suggests an aspect of the week's topic, and expresses his or her point of view. Besides the message via Seminar, using this message as a hook the leader also posts three messages in the Question category for the other learners to discuss during the week. During this argumentation period, the conference leader is responsible for animating and keeping the Conference discussion dynamic. The moderator, meanwhile, is responsible for leading the *Debate* (chat), and the other learners are expected to participate in the Conference and Debate discussions, entering into greater detail regarding the topics under review. The refining of the methodology and the adoption of message assessment and structuring lead to the progressive increase of the number of messages per participant, from less than 15 in 1999.2 to 33 in 2000.1, 44 in 2000.1, 43 in 2001.1 and 53 in 2001.2.

4.5. Collaborative Production and Evaluation of Educational Content

At the end of the first part of the course, the students are put into groups of two to three people, based upon the profiles they had previously submitted. In this profile, the learners select their skills and interests in each one of the topics on the course. Based upon these selections, AulaNet suggests the group formations that best satisfy the criteria defined by the mediators (degree of skill and interest). The learners are then told about the groups and their respective topics. They may negotiate another topic with the mediators, as long as it is within the scope of the ITAE field of study.

The group organizes itself in order to produce interactive multimedia educational content and must submit it by a given date. Then, a period of collaborative evaluation begins during which time each group's content is assessed by the members of at least three other groups. This grading takes place in Conferences created specifically for this purpose. During these conferences, the learners discuss the problems regarding the content that has been produced. Once this period is over, the groups are given a new deadline to present a revised version that incorporates the contributions of their colleagues. The mediators evaluate this revised content and may select some of the work to become a part of the course.

5. CONCLUSION

During the nine editions since 1998, when the ITAE course was first offered by PUC-Rio as a regular subject, many observations and considerations have been obtained which may be useful in order to prepare and perfect distance-learning courses via Internet. The AulaNet environment and ITAE course create a platform where it is possible to collect data and make experiments while the participants are working on the course. It is possible to observe how participants interact with the environment, collecting and analyzing data such as messages, grades, discussion threads, contact information and self-reports. Some results obtained can be found in [6] and [12]. These experiments and observations help to continually improve the environment, the course and the collaboration model presented in Section 2.

In the ITAE course, most of the communication and all content self-study is conducted asynchronously. In asynchronous events, learners can participate at a time and place convenient to them and appropriate to the task, having more time to reflect before composing their messages. In addition, although extrovert personalities send more messages than shyer members, they cannot dominate completely as in face-to-face

or synchronous situations. Quieter members still have the opportunity to contribute, as described by [13]. However, by reducing the pressure to respond, since it can be done at any time, it is easier for a student to drop out of the group [14]. The mediators found that they had to demand regular contributions in an appropriate timeframe to avoid dispersion. The *Follow-Up* reports helped to identify who was or was not participating.

Communication among participants took on a fundamental role in the learning process through exchange of information and points of view. It also interconnected the group and made it possible for the mediators to coordinate activities and organize the participants, aiming for collaboration. Moreover, as described by [2], working with peers tended to reduce anxiety as learners discovered solutions to complex tasks, increasing satisfaction with the process and results. The groupware technology supported the collaborative learning activities, providing an environment where group interaction took place.

ACKNOWLEDGEMENT

REFERENCES

1. Benbunan-Fich, R. & Hiltz, S.R. "Impacts of Asynchronous Learning Networks on Individual and Group Problem Solving: A Field Experiment," *Group Decision and Negotiation*, V8, 409-426, (1999)

2. Harasim, L., Hiltz, S.R., Teles, L. & Turoff, M. "Learning networks: A field guide to teaching and online learning," 3rd ed., MIT Press, (1997)

3. Hiltz, S.R. "The Virtual Classroom: Learning without limits via computer networks," Norwood, New Jersey: Ablex Publishing Corporation, (1994)

4. Turoff, M. & Hiltz, S.R. "Computer Support for Group versus Individual Decisions," *IEEE Transactions on Communications*, 30, (1), pp. 82-91, (1982).

5. Zaina et al, L.A.M. "Analysis and comparison of distance education environments," *Proceedings of ICEE 2001*, <http://fie.engrng.pitt.edu/icee>, (2001)

6. Gerosa, M.A., Fuks, H. & Lucena, C.J.P. "Use of Categorization and Structuring of Messages in order to Organize the Discussion and Reduce Information Overload in Asynchronous Textual Communication Tools," *7th International Workshop on Groupware*, CRIWG 2001, pp 136-141, (2001)

7. Kunz, W. & Rittel, H. "Issues as elements of information systems," *Working Paper no. 131*, Institute of Urban and Regional Development, Univ. of California, Berkeley, (1970)

8. Burd, B. "Using the Internet to Teach Software Engineering," *Electronic Proceedings of the INET'97*, Internet Society, (1997)

9. Thorpe, M. "Assessment and 'third generation' distance education," *Distance Education*, 19 (2), pp 265-289, (1998)

10. Dushastel, P.A. "Motivational Framework for Web-Based Instruction," *Web-Based Instruction*, Educational Technology Publications, (1997)

11. Salmon, G. "E-moderating: the key to teaching and learning online," ISBN 0749431105, (2000)

12. Fuks, H., Gerosa, M.A. & Lucena, C.J.P. "The Development and Application of Distance Learning on the Internet," *Open Learning*, Vol. 17, N. 1, ISSN 0268-0513, pp. 23-38, (2002)

13. Straus, S.G. "Getting a clue: the effects of communication media and information distribution on participation and performance in computer mediated and face-to-face groups," *Small Group Research*, 27 (1), 115-142, (1996)

14. Graham, M., Scarborough, H. & Goodwin, C. "Implementing Computer Mediated Communication in an Undergraduate Course - A Practical Experience," *JALN*, Vol.3 No.1-May, (1999)

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