Analyzing and Assessing Collaborative Learning Activities in a Web-Based Environment

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Abstract — *Upon adopting a collaborative learning strategy for a Web based course, it is necessary to use assessment techniques that take into account the interaction of individuals with their colleagues instead of basing them only on individual progress and activities. The AulaNet learning management system offers participation follow-up reports that provide the group with coordination information, making it possible quantitative and qualitative performance analysis. The Information Technologies Applied to Education course is presented as an example of the use of the environment in a course that is entirely taught through the Web. Aspects of the assessment of collaborative activities and the ensuing follow-up reports are presented in the paper.*

Index Terms — *assessment, cooperative learning, distance learning, Web-based instruction.*

MODELING COLLABORATION

In order to collaborate, individuals must debate ideas (communicate), be in tune with other participants of the group (coordinate) and operate together in a shared space (cooperate). Successful communication results in commitments assumed by the receiver, by the transmitter or by both. Coordination deals with conflicts and organizes the group in a manner that avoids that communication and cooperation efforts are lost and, furthermore, to ensure that the tasks that are the result of the commitments that have been assumed are carried out in the correct order, at the correct time, and comply with the restrictions and the objectives. Cooperation is the joint operation of members of the group in a shared space, seeking to complete the tasks that are managed by coordination. This model [2] guided the development of the AulaNet environment.

The AulaNet is a free (http://guiaaulanet.eduweb.com.br) learning management system that is based upon a groupware approach for the Web. The Information Technologies Applied to Education (ITAE) course is taught entirely at distance through the AulaNet environment. The course prepares its students to work in groups using information technologies, transforming them into Web based educators [1]. The course has been offered every semester since 1998 as one of the undergraduate and graduate offerings of the Computer Science Department of the Catholic University of Rio de Janeiro (PUC-Rio).

Given that collaborative activities are encouraged, the learners are assessed on the contributions that add value to group learning and not just for their individual activities [4]. The AulaNet is organized into communication, coordination and cooperation services that are based upon the concepts described above. Since the ITAE course is centered on learner collaboration through communication services, these services and their use are presented, as are some reports that are examples of the kind of assessment that is conducted through out the course. It is important to note that the purpose of this paper is not to show how to assess students in a collaborative way, but it intends to exemplify how the computational support offered by AulaNet can be used to do that.

ASSESSING COLLABORATIVE ACTIVITIES

The collaborative activities that are presented on this work are based on two communication services used within ITAE namely *Conferences* and *Debate*.

The Conferences Service

The Conferences service functions like an asynchronous forum. The structuring of the messages make it possible to organize the discussion by subjects, avoiding that messages of one sub-topic mix with those of another one. The conferences are used in the ITAE to discuss the course subjects in greater depth.

In AulaNet teachers can play three different roles: Coordinator (who organizes and creates the course contents), Teacher Co-Author (who helps the coordinator in creating the contents) and Mediator (who is responsible for applying the course, grading students etc.).

Commonly, it is the role of mediators of a course to conduct the discussion and to transmit information. But in the ITAE these tasks are shared with learners. Even without the technological support of the environment, a special role for the learners were defined: leader of the conference. The learners take turns in that role during the course, which is divided into weekly modules.

The conference leader is responsible for posting a message, called seminar, about that week's subject on the Conferences service. Besides the seminar message, the conference leader sends out three messages containing questions for discussion during the week. Both the seminar and questions are sent to an exclusive conference for the subject of the week. Learners (leaders of the conference) are instructed to prepare questions with a well-defined focus so that the discussion can be deeply rather than widely developed. An excessive number of questions would disperse other learners' arguments.

During the argumentation phase of the conference, the seminar leader also is responsible for fostering and maintaining group animation, proposing new questions whenever the initial ones seem to have outlived their usefulness. The mediators (teachers) grade and comment on all conference's messages posted within a stipulated timeframe.

Assessment is conducted to verify if a message is well structured, if it is based upon a well-articulated argument, if it presents references and if it is: well positioned, well written, clear, objective, organized, cordial and concise and falls within the context of the overall discussion. Besides grading a message, mediators compose different commentaries for the entire class, for the author of the message or only for the mediators. In these comments, they show the positive and the negative aspects of the messages and justify the grades that have been given. However, mediators do not immediately point out some conceptual problems contained in the messages, since the errors do not compromise the learning experience. This allows other learners to view and discuss the problems.

The learner in the ITAE is instructed at the beginning of the course that receiving a low grade for a message is an indication that there is a problem with the message (and not with the learner), and that this grade will not affect directly his or her final grade if there is an effort to improve. At the end of the course, a questionnaire is applied to the learners and the majority of them agree that the assessment of and the comments about their messages improved the quality of the arguments.

All the reports offered by AulaNet can be available only for teachers or for teachers and learners, helping peer assessment. This will depend on the coordinator's (teacher) choice when creating or updating a course. The AulaNet offers a report where the performance of the learners for each one of the conferences (subjects) is presented, as shown in Figure I. For example, this report makes it possible to observe the quality and the quantity of the learners' contributions. The first information presented in each cell is the number of messages sent by the learner. This information is more explicit in the report than it is in the conference. The information that comes afterwards within the same cell is the consolidation of the learner's grades, using an arithmetic average of the grades of the messages that were sent to the conference without considering the contributions not graded ("Not Available") and contributions that did not added value to the discussion ("Not Applicable"). If a learner did not participate in a conference, his or her cell in the report is filled in with a different color. This calls the mediators' and the group's attention to those who have not collaborated.

Since the course began in 1998, it has been evolving and sometimes it is not easy to extract and analyze information. For example, in the statistics presented below we have two periods that are not comparable because there was a contents of some week modules were condensed in just one week in the second period. So we could not compare messages of conference X of the first period with conference X of the second period since they were about different subjects. The first period comprises data from the second semester of 2000 (2000.2) and the first semester of 2001 (2001.1). The second period comprises data of the second semester of 2001 (2001.2) and the first semester of 2002 (2002.1). It is important to remember that the number of semesters used on the analysis is short and so it is not sufficient to imply "definitive conclusions" about the course.

* A conference and a debate were purged from the statistics, since they did not occur in 2001.1.

Analyzing the data on Table I, it is not possible to compare the number of messages since the number of learners is different in each semester. However, an interesting aspect that emerges is the amplitude. It presents the difference between the maximum and minimum of messages sent by a learner to the conferences. The peak of the amplitude took place in 2001.2, which indicates learners did not contribute in an egalitarian way in the Conferences service.

Although the number of messages is not comparable, the mean of the number of messages sent to the conferences can be compared as it is shown in Figure II.

The mean of the number of messages starts with a low value and booms on the second conference. After that, the number of messages starts to recede; with a few variations. At the end of the course the mean is higher than at the beginning. In the first conference, it can be pointed out that learners neither know how to use the environment nor the course's dynamics. The peak at the second conference could be explained by the learners' desire to participate. However, at this point mediators start grading their contributions. This way, learners start to reflect more when sending messages.

The Debate Service

In the ITAE, besides being discussed asynchronously in the Conferences, the subjects are also discussed synchronously once a week on a textual chat. As in the Conference, a special role for the learners was also defined: moderator of the debate. The learners take turns in this role during the course. During the weekly debate, the learner that plays the role of debate moderator appears on stage. The task of the moderator is to manage the debate, proposing topics to be discussed, coordinating the participants, maintaining order, making sure the pace of the debate is neither too fast nor too slow and keeping the debate focused. It is very easy to get off track in a chat, with lots of people typing at the same time, many different ideas and parallel or unrelated subjects appearing. But it is the task of the mediators (teachers) to grade the participation of the learners in the debate.

It is expected that the learners' arguments duel and that the learners are mature enough to accept the positions and the arguments of others, learning something from them. In the ITAE, argumentation that is generated from the confrontation between different ideas is valued. It is expected that learning should derive from these arguments and the respective aligning of ideas and not from harmonization and consensus.

Each week different learners are chosen to play the role of conference leader and of debate moderator. It is the other learners' duty to participate in the conference and in the debate, delving deeper into the topics in question. Thus, the course mainly is centered on learner collaboration through communication tools and an exchange of roles between mediators and learners.

*The first conference and the first debate are not considered in this analysis because they are not graded [5].

It is clear from Table II, that the participation on the conferences and on the debates is high. However, considering the number of learners that joined in the conference and in the debate, during the same week, the results are very low: in the first period only 38.1% and in the second 38.2%. Hence, learners tend to prioritize participation in one of the above mentioned services.

The AulaNet offers a report about the Debate service where it is possible to view who was present during each one of the sessions and its corresponding grade. This report merges quantitative and qualitative information, providing participants a visualization of the quality of the interaction of the debaters and how they evolved over the period.

As pointed before, the kind of assessment in each one of the services is different, but it is interesting to compare them. It is clear from Figure III, that the average grades on the debates are lower than on the conferences, with the exception of 2001.1. Given that the debate is a synchronous activity, this situation could be explained from two different viewpoints: learners have more difficulty in expressing themselves and following the discussion and mediators do not have technological support for analyzing synchronous activities. On the other hand, on asynchronous and structured activities like the weekly conference, both learners and mediators have more time to reflect, resulting in better contributions [3].

ASSESSMENT BASED UPON COLLABORATIVE ACTIVITIES

In a traditional face-to-face classroom, teachers direct their classes and discourse based upon visual observation of the reaction of students. This information is difficult to obtain in a distributed and asynchronous teaching environment. The AulaNet follow-up reports reduce this problem by supplying a general view of the quantity and the quality of individual contributions. The quantity can be extracted automatically, but the mediators must examine and grade each contribution in order to evaluate the quality of the learners' participation. In the ITAE, grades are assigned to conference messages and participation in the debates. In the Conferences, the form and the content of messages are evaluated. In the Debate, the quantity of messages and the quality of the messages sent to the session is considered on the assessment.

The assessment provides feedback to teachers and learners, making it possible to reformulate the teaching and learning strategies. The evaluation of the learners in Web courses should not be based solely on isolated activities [6].

The follow-up reports help learners situate themselves in the course's events and let them evaluate and compare their progress against that of their colleagues. Sometimes this assessment leads to healthy disputes, according to learners. However, the mediator must pay attention so that disputes do not go beyond the scope of ideas and generate interpersonal conflicts. The reports display quantitative and qualitative statistics about learner participation. They make it clear who is participating and can provide clues about what a learner has learned and what are his or her difficulties in terms of a specific service or regarding the course as a whole.

Asynchronous communications services normally are used to encourage reflection, since participants will have more time to act. In a synchronous communications service, interaction is valued once the response time between a participant's action and the reaction of the other participants is very short. Thus, contributions on the two types of services must be evaluated in different ways.

Overall Assesment

The analysis of quantitative data or the punctual analysis of quantitative and qualitative data is not sufficient for the assessments required for a course such as the ITAE. So there are reports that do supply information for general analysis of the

quality of the participants' contributions: Average Percentage of Effective Contributions to All Services (Figure IV) and Average Grade of the Participants. In the report shown in Figure IV, the average quantity of contributions is next to the name of each service as well as the average percentage of effective contributions.

The average quantity of the contributions is obtained by dividing the number of contributions sent to the service by the number of participants in the class. The average of the effective contributions is obtained by dividing the number of contributions to the service that have received grades different than "Not Applicable" or "Not Available" by the number of messages that have been graded.

The report shown in Figure IV also supplies the number of contributions in each service and the grades that have been received by a learner. For example, the cell for Bernardo in the Conferences reports that he contributed with 20 messages, of which five did not receive a mark (Not Available) and one did not add value (Not Applicable). The number of messages that he sent is greater than the class average and, thus, his cell is not in a different color. Another view of Bernardo's participation is obtained if the feature of the report for viewing the cells in a different color regarding the percentage of effective contributions is used. One can see that the learner's effective contribution (93.33%) is lower than the class average (97.83%). In this case, the difference is not worrisome, but there are cases when a learner makes many contributions but the percentage of effective contributions is low; that is, he or she is generating lots of noise in the communication hence her contributions do not add value.

The learner's average grade appears in the last column of the report shown in Figure IV. The average grade is one of the pieces of information contained in this report that will be next discussed. The Average Grade of the Participants in All of the Services Report presents a view of the quality of the contributions over the period the course was taught. The average grade is the weighted arithmetic average of the grades that were received in each service.
However, detecting participant shortcomings and mistakes is not that easy. For example, if a learner sends a number of contributions that do not add value and some contributions that are very good, upon calculating the average grade of the participants "Not Applicable" marks are not considered while the good contributions raise the average grade. Yet, it is known that this learner generates lots of noise, since he receives a number of "Not Applicable" grades. This information is not visible in the Average Grade Report (not shown in this paper) but can be seen in the Average Percentage of Effective Contributions Report. Thus, the AulaNet reports complement each other and should be used together.

FINAL CONSIDERATIONS

The ITAE course, which is entirely taught at distance on the AulaNet environment, was designed to train educators in the use of the Web. In this course, they must generate knowledge in a collaborative fashion, seek their own sources of information and put their ideas into discussion. Nevertheless, following up learner participation takes up a lot of a mediator's time and demands redoubled attention. In order to facilitate this follow-up process, the AulaNet offers reports containing information about the quantities and the types of learner participation, which are used by the teachers to get to know better their students and to motivate them; and the students use them to evaluate their level of participation. It is up to the mediator to maintain order and to evaluate and correct mistakes; mediators also must be careful not to allow their attitudes to inhibit learner participation. They must constantly monitor the course. A delay in answering and orienting the group can cause anxiety and frustration and the discussion can turn into a non-productive activity.

The AulaNet environment helps teachers make teaching content available on the Web and provides integrated communication, coordination and cooperation services to support groups. The environment also supports learner assessment and follow-up through continuously updated awareness information based upon their participation in collaborative activities.

ACKNOWLEDGEMENT

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FIGURES AND TABLES

FIGURE I
LEARNER FOLLOW-UP REPORT BY CONFERENCE

TABLE I
DESCRIPTIVE ANALYSIS OF THE NUMBER OF MESSAGES SENT TO CONFERENCES

	Period 1		Period 2	
	2000.2	2001.1	2001.2	2002.1
Learners	8	16	15	19
Conferences	13*	13	8	8
Messages	247	605	485	446
Minimum number of messages sent by learner	0	0	0	0
Maximum number of messages sent by learner	14	12	22	12
Amplitude (%)	14.17%	4.91%	21.65 %	11.43 %

FIGURE II
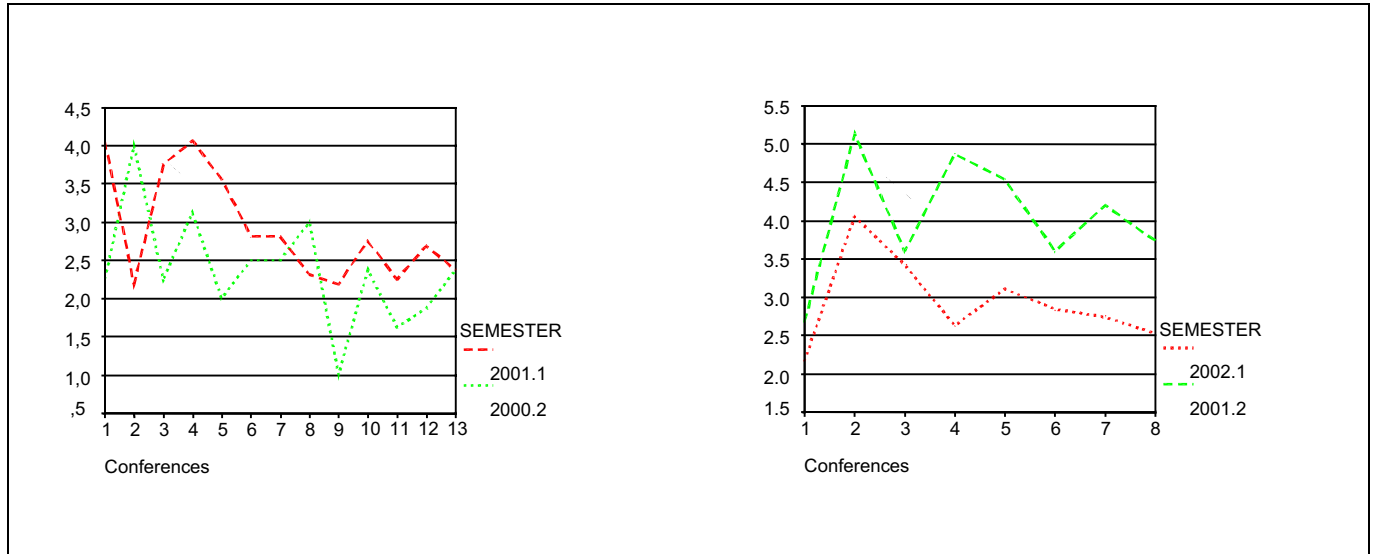EVOLUTION OF THE MEAN OF THE NUMBER OF MESSAGES ON THE CONFERENCES SERVICE

TABLE II
DESCRIPTIVE ANALYSIS OF THE PARTICIPATION ON CONFERENCES AND DEBATES

	Period 1		Period 2	
	2000.2	2001.1	2001.2	2002.1
Learners	8	16	15	19
Conferences	12*	12	7	7
Participation (conferences)	76.43 %	86.65 %	87.72 %	85.71 %
Debates	12	12	7	7
Participation (debates)	84.48 %	90.12%	91.43 %	93.23 %

FIGURE III
AVERAGE GRADE IN CONFERENCES AND DEBATES
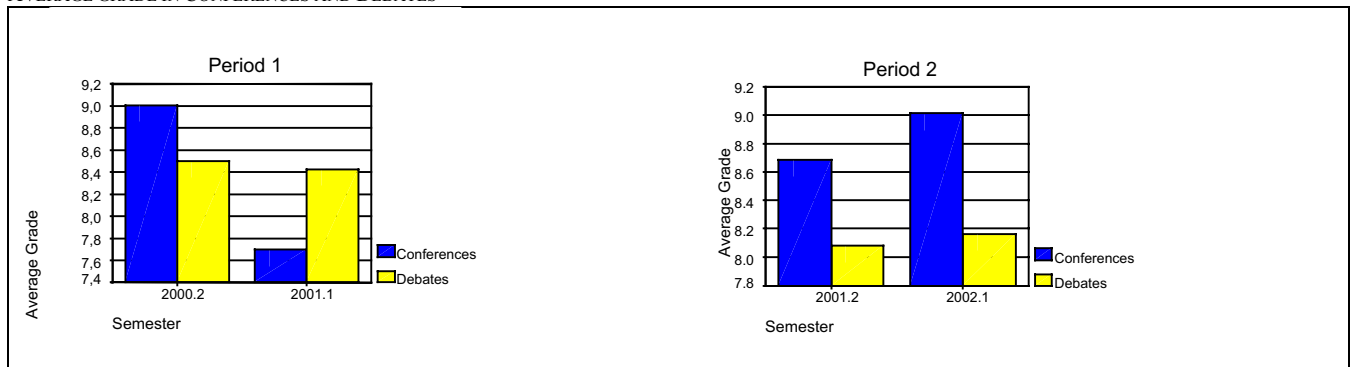
FIGURE IV
AVERAGE PERCENTAGE OF EFFECTIVE CONTRIBUTIONS REPORT HIGHLIGHTING THE LEARNERS