Using a Groupware Technology to Implement Cooperative Learning via the Internet – A case study

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Abstract

The Internet presents numerous new resources for teaching/learning. Despite this, it also brings many difficulties. To get around some of them, the AulaNet environment was developed in a way that teachers could concern themselves about producing educational content while the environment manages the learners' navigation for them. Moreover, the environment offers integrated communication, coordination and cooperation services that can be added on to the course in order to supplement it. The course on Information Technology Applied to Education is wholly taught via the Internet through the AulaNet environment. The purpose of the course is to get students to learn to work with information technology as a group, turning them into Web-based educators. The class has been conducted since 1998. This paper reports how the AulaNet was configured and how its services aided in the creation and application of the course during the period from 1998 to 2001. The result of this work is an experience in which it has been possible to analyze development costs, updating and application, how to encourage learner participation, what should be the size of the ideal group and a form of assessment of the learning experience based on the cooperative activities.

1. Introduction

The pace 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, but besides having the knowledge necessary to do their jobs, they must possess other, perhaps more important, skills [2]. They have to know how to learn, so that they are able to continually adapt themselves to the knowledge production rhythm and to the evolution within the work environment. They have to know how to creatively change an old knowledge set into new knowledge, an important element in modern institutions. Moreover, they have to know how to work within a group, which is one of the aspects most required today by corporations.

Normally, a group has the capacity to produce better results than any of its members acting alone [3]. Working in group brings some characteristics such as synergy, the ability to consider more information, objective evaluation, cognitive stimulation and member learning from other members [4], which can be very useful to improve the learning process. The use of the Internet to implement group cooperative learning minimizes temporal and geographical barriers and offers a number of resources to facilitate group interaction and the presentation of content [5].

In order to train workers in the new skills that are required and to make use of the advantages provided by group learning via the Internet, education is undergoing a process of adaptation [6]. The use of the Internet helps in the implementation of cooperative learning [7], allowing for a rich exchange of information between members of a knowledge community.

Although the Internet offers advantages and facilities for teaching/learning, there also are many difficulties associated with its use. For instance, if their institution does not provide support for Web content development, teachers must comprehend technologies that normally are not part of their expertise to produce interactive contents. To reduce these difficulties they can use environments that separate content from navigation. This lets them concentrate on the production of educational content, using habitual tools such as word processing programs, while leaving the management of the learners' navigation to the environment. Additionally, without much effort, they can add integrated communication, coordination and cooperation services to the course in order to facilitate and encourage work within a group. Moreover, they can use reports supplied by the environment to follow-up learner participation.

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 [8]. The class has been conducted since 1998 as a regular course and currently is wholly taught on the Internet through the AulaNet environment [6].

The AulaNet is a learning environment that was developed based on a groupware approach, for helping teachers in the arduous task of implementing an Asynchronous Learning Network (ALN). It supports "anytime/anywhere" interaction among students and between students and instructors, and manages learners' navigation through content.

In this paper, the results that have been obtained and the difficulties that have been encountered in the development, application and integration of the course with the groupware environment is reported. This experience will show how the groupware technology could be useful in the implementation of cooperative learning via the Internet.

2. The ITAE on the AulaNet environment

The AulaNet[1] is a freeware environment based upon a groupware approach for the creation, delivery and administration of Web-based courses. The Software Engineering Lab of the Catholic University of Rio de Janeiro has carried out its development since June 1997, with doctorate, master's degree and undergraduate students, who maintain the code and improve it with topics from their research. A comparison with others environments can be found at [9].

Figure 1. AulaNet interface

The AulaNet environment offers a standardized interface for taking courses on the Web. As shown in Figure 1, this interface is made up of a menu that is

presented graphically as a remote control unit, which provides access to the course's services, and windows where the learner interacts with the course's contents, with the instructor and with the other learners.

The AulaNet's groupware approach has a fundamental role in Internet courses since it is through cooperation between learners in a group where rich experiences occur, generally more than through individual study of the content of the course [10].

If the discussion takes place in a group setting, higher order cognitive skills are developed. The contribution of different understanding or the exposure to alternative points of view can enhance learning [11]. Group members can monitor individual thinking and provide feedback, the exposure to alternative points of view challenge understanding and motivate learning, and the group structure provides social support and encouragement for individual effort [4]. Groups, in general, also are better than individuals at making decisions. This is so partly because 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 [12]. Also, through formulating ideas in their words, and receiving evaluation from peers, students' knowledge, thinking skills and meanings are socially constructed [5].

Besides the advantages of learning within a group, there are also potential problems, such as free-riding, social loafing, status differential effects and diffusion of responsibility that may hinder some of the advantages if not well managed [13].

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) [14], as shown in Figure 2. The group work takes place mainly through the communication, which interconnects the group in order to have the coordination and show the results of the cooperation.
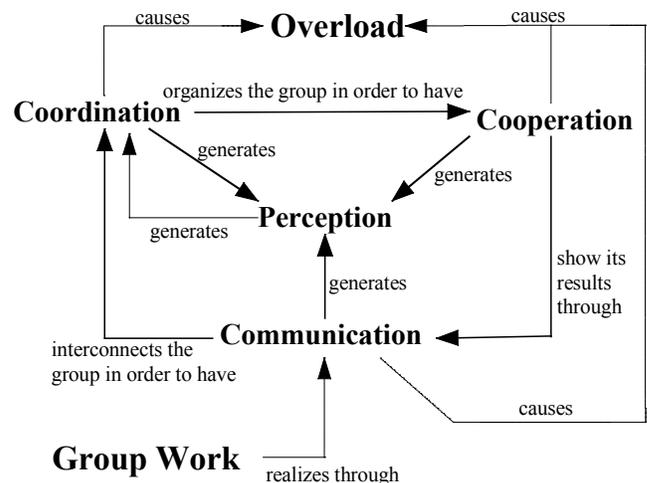

Figure 2. Modeling group work [30,31]

[1] AulaNet - http://guiaaulanet.eduweb.com.br

Communicating is sharing. Melody [15] makes a correlation between information and communication and affirms that the functioning of a community depends on information and the efficiency of communication between its members. The communication shows the results of the cooperation and interconnects the group in order to have the coordination.

Conversation for action generates commitments. To satisfy these commitments and for the organization of the participants it is necessary to coordinate events. Without this coordination, part of the communication effort will be lost, not turning into cooperation. That is why there is a need for distinguishing different stages: in order to have cooperation, coordination is necessary, and in order to have coordination, communication is necessary [14].

All the communication, coordination and cooperation events generate information that is perceived by the participants and can cause information overload [16].

The AulaNet and the ITAE were designed from the principles described above. The AulaNet services are divided into communication, coordination and cooperation services. These 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 the ITAE, the teacher adds services to the course as it unfolds in order to smooth the absorption of the environment by the learners.

2.1. Communication services

The communication services provide the facilities that permit the exchange and sending of information [17]. These services include: individual electronic mail exchange with the instructor (**Message to Teachers**); electronic mail with the entire group (**Discussion Group**); asynchronous text discussion tool in a forum style (**Interest Group**); synchronous text conference tool as chat (**Debate**); and tool for the instantaneous exchange of messages with participants who are connected to the course (**Contacting the Participants**). Since ITAE is a course that is based mainly on participant interaction, it uses all of the communications services.

The **Message to 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 learner's choice, 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 through text 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 of the **Discussion Group**, even if they do not enter the environment. In the environment, the messages are shown as a chronologically sorted list. In the ITAE this service is 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 to messages in order to answer, comment and criticize or whatever else. The replies appear indented underneath their related messages, forming a threaded discussion, as shown in Figure 3. This structure permits organization by topics, with related messages below the original topic message. In the ITAE, the **Interest Group** service is used to develop in depth course themes and topics selected by the group.

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 debates.

Finally, the **Contacting the Participants** service lets members who are simultaneously connected to the environment contact each other through messages that open up in new windows. This does not have a specific purpose in ITAE, but the participants use it to communicate individually during a debate, to request information or even just to greet each other. In Table 1, some of the characteristics of the communication services are shown.

Table 1. AulaNet communication services

Service	Sender-Receiver	Type
Message to Teachers	one-teachers	asynchronous
Discussion Group	one-group	asynchronous
Interest Group	one-group	asynchronous
Debate	one-group	synchronous
Contacting Participants	one-anyone	synchronous

The AulaNet implements message categorizing in the **Discussion Group** and in the **Interest Group**. The message categorizing helps organize large volumes of messages, reducing information overload on the participants [18]. The coordinator chooses desired categories and, upon sending a message, participants have to select the one that most reflects their intention. Categorized, the messages can be automatically grouped by reports that could be used to better understand how the discussion is proceeding and the types of the learners' contributions. It also makes the participant reflect about the content of the message, improving the quality of the discourse and making the discussion more explicit [18].

Figure 3. Dialogue in the Interest Group

2.2. Coordination services

Individuals working alone draw from their own knowledge base and sources of information, and endure only self-coordination problems in order to accomplish a task. When working in a group, members' coordination problems appear. The coordination services are designed to minimize these problems, for example organizing the group with the means for managing the group's agenda and competence. These services in AulaNet 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 **Follow-Up 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 also permits configuring so that 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 viewing their work [19]. Moreover, it also offers examples for those who are still developing their own topics.

The **Lesson Plan** is where the teacher structures the course's educational content, separating them into classes. These classes follow an order that is suggested, but not imposed, indicating a basic flow for the course. The learners can access any content at any time of the course. In the ITAE the lesson content is made up of video, slide presentations and supplementary texts. The environment also allows learners to take private notes on a class that

remain on file for their personal viewing, allowing them to save, for each content, doubts, observation, comments, pending tasks, etc.

Figure 4. Follow-Up Report highlighting an unaccomplished task

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. 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 varying from 0 to 10, in intervals of 2.5. 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. In Figure 4, a report showing learners who did not accomplish a task is shown.

2.3. Cooperation services

The cooperation services provide the means for cooperative learning [5], problem resolution and course

co-authorship, both for teachers (**Teacher Co-Authorship**) and for learners (**Learner Co-Authorship**). The cooperative services also include a list of extra contents 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 needs to be checked by the teacher.

Although the task performance is contingent upon contextual factors such as group composition, members' characteristics and abilities, task type and technological support, the cooperation mechanisms support the interaction among the members of the group in order to minimize contextual difficulties [4].

3. Construction and refining of the course

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 train educators to use the new technologies for teaching/learning, and to develop a community of persons who are interested in the subject. The course was taught for the first time during the first half of 1998 and had one edition per semester.

In AulaNet courses, teachers can have three different roles, which can be assumed by the same person or not. 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 the course content. The instructor's role is to animate the group, maintaining order, motivating and evaluating learner participation. In the ITAE there are two coordinators who also assume the author's role, and there are instructors who vary from one semester to the next.

3.1. Content preparation

In order to develop attractive content, besides understanding of the subject matter, other skills are normally required such as graphic design skills and Web programming, which the teacher generally does not possess. The ideal situation is for the 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 did not have such resources, it was developed over time and a large portion 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 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 teachers' presentations during the weekly classes and by copying the transcripts of the chat sessions. As it was 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.

Each subsequent edition of the course, with some adaptation, took advantage of the content produced in the previous ones. In some editions, the learner's final task was to prepare a new class or paper about a theme that had been discussed in the course, helping the generation of the 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 instructor to constantly check all references.

Moreover, the cost of monitoring the learning process [20] uses up a lot of an instructor's time. The instructors must accompany, assess and motivate the learners and answer their doubts. They must constantly monitor the interactions in order to maintain the order and the netiquette, and give timely feedback to the group, avoiding anxiety and frustrations. The anxiety produced by delays and different participation rates may reduce the quality of decision making, because members may go along with an initial suggestion, even if they do not agree with it, in order to accelerate the process and meet a deadline [21].

3.2. Group organization

In the initial editions, besides the regularly enrolled students, outside individuals were allowed to participate in the course. This resulted in more than 100 learners. The excessive number of participants made it difficult to prepare a cooperative learning process in which everyone was able to participate. Hundreds of messages were

posted weekly in the **Discussion Group** service, making reading them all before the debate an arduous task. To solve this communication overload problem [16], 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 did others. The presence of "tourist" students, who entered the environment on an occasional basis, inhibited some participants. The lack of a reward that served as a commitment for participation can bring unexpected effects in terms of the lack of interaction. These rewards can be economic (e.g. money or prizes), academic (grades) or social (public exposure of individual outcomes) [22].

3.3. Evaluation of the learning process

Evaluation of learners in the ITAE is based on their participation and the quality of their contributions [23][24]. Although the AulaNet contains an evaluation service 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 accompany the students and to make it possible for the learners to evaluate their own level and quality of participation, follow-up reports of the environment were used to present information about the quality, quantity and type of participation [25]. As qualitative information cannot be extracted automatically, the participation had to be evaluated by the instructor, who needed to grade individual participation in the **Debate** and the messages in the **Discussion Group** and in the **Interest Group**.

The message evaluation provided feedback to the authors 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 on 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 dearth 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.

3.4. Participant introduction to the course

To break the inertia and initial fear of the participants, and bring them closer together as a group, since the fifth edition of the course learners have been asked to introduce themselves to the group during the first week.

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 seminar 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 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.

3.5. Content discussion

To encourage the learners' involvement with the course, each was designated a seminar leader for one of the weekly topics. This individual was responsible for researching the discussion topic and preparing the Seminar, 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 in greater depth into 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 train instructors to teach courses via the Internet, this way they are learning by doing.

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 shown in a chronologically ordered list, the messages were intermingled, making the list disorganized.

As of the sixth edition of the course, in 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 **Discussion Group** service was left for group coordination.

Message categorizing was also adopted in the TIAE. In the fifth edition of the course, the first time when 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 category. The use of categories made the messages more organized and facilitated the identification of the content of the messages [18].

In the sixth edition, in order to reduce the number of messages without categories, their content was analyzed and three new categories were created for them. These new categories were notice for notices, *Monograph* for messages related to the learners' final task and *Evaluation* for the learners to evaluate the course.

The categories *Seminar*, *Contribution about the Seminar* and *Question* were transferred, with the themes' discussion, from the **Discussion Group** to the **Interest 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 was *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 in each semester can be seen in Figure 5, where DG means a **Discussion Group** category and IG is an **Interest Group** category. Both the editions had approximately the same number of participants: nine on average.

The transfer of the discussion of the course content from the **Discussion Group** to the **Interest Group** made it possible to increase the discussion about the course's subjects, raising the total number of messages from 288 to 446. The quantity of messages for discussion 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 during the fifth edition (20 messages). This indicates a deeper discussion about the themes of the course. The *Case* category practically was not used and there was a significant decline in the quantity of *Generic* messages in the **Discussion Group** (72 to 20) with the adoption of the *Notice*, *Monograph* and *Evaluation* categories.

3.6. Regarding Communication services

The **Discussion Group**, based on a mailing list, was suitable for notices, discussion about the course and other coordination messages because of its characteristic of being sent to the personal mailboxes of the participants. The **Interest Group** was suitable for the discussion of the course's topics, since it made possible to organize the messages into topics as well as to structure the argumentation. As for the **Discussion Group**, it is an asynchronous communication tool, where the participants have more time to prepare their messages, and thus they are more elaborated and better thought out than the ones from the synchronous services such as **Debate**.
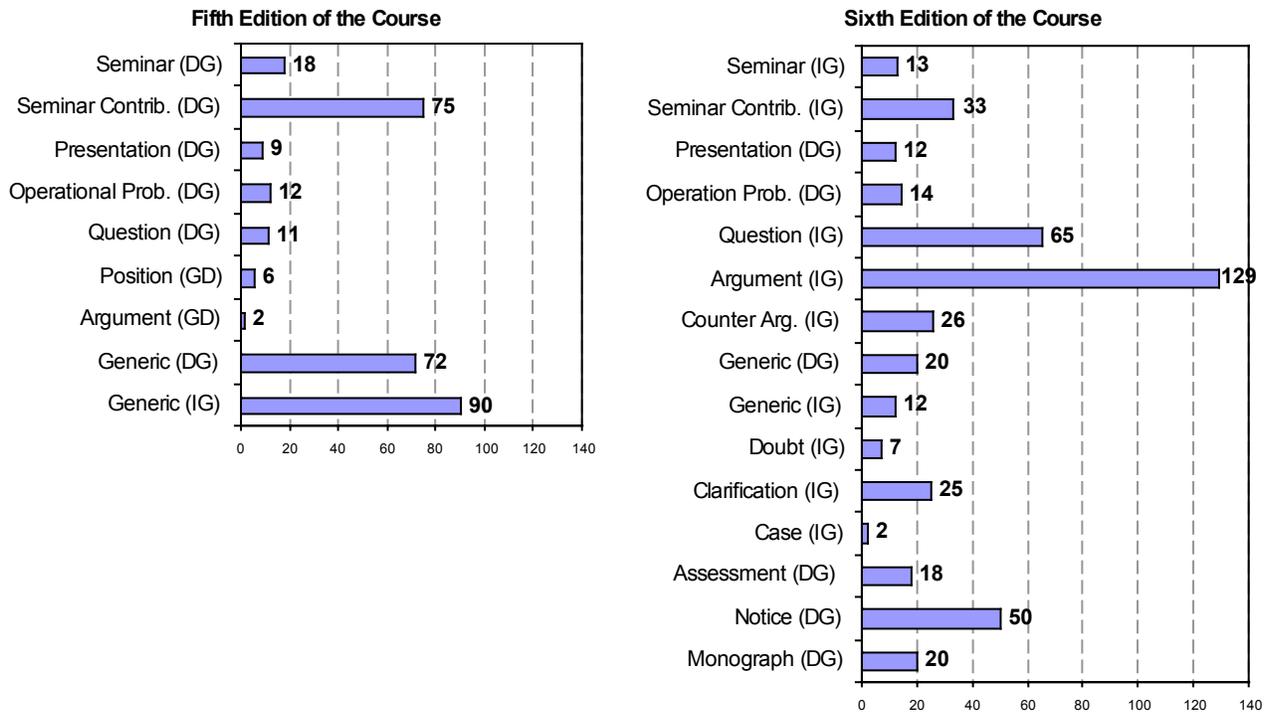
Figure 5. Number of messages in each category in two semesters

During the conversation in the **Debate**, which is based on a textual chat, the time to answer questions is limited, something that usually makes the contributions short, not particularly well elaborated and full of abbreviations and typing mistakes that are tolerated as long as they do not distort meaning. Moreover, since the participants wrote their messages while other messages also were being written and sent, the topics intermingled and the focus of the conversation changed frequently [26]. Despite its difficulties, the **Debate** generated a sensation of proximity between learners and instructors, according to an evaluation of the learners, and the discussion of the topics took unexpected directions made possible as a result of collaboration within the group, generating new questions and ideas.

3.7. Learner participation

Although the participation of the learners during the course had been satisfactory, there were times when the level of interaction began to decline, requiring the intervention of the instructor, who had to send out motivational messages to individuals or to the group. Other factors that harmed the level of participation were the difficulty of using the environment and the inhibition of learners afraid of exposing themselves. The instructor had to maintain order, evaluate and correct mistakes while taking care not to inhibit learner participation.

As can be observed in Figure 6, with the refining of the methodology, the increased experience of the instructors and, mainly, with the adoption of the categorization of messages and structuring of the discussion [18], the number of messages in the course has increased over the latest editions. Although this growth does not necessarily correspond to a quality increase, according to the evaluation made by the instructors, it was reflected in the further analyses of the subjects of the course.
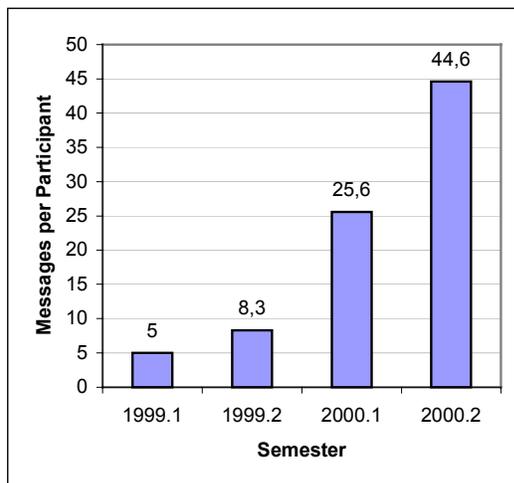

Figure 6. Number of messages per participant

5. Conclusion

Some observations and considerations, which may be useful in order to prepare and perfect distance-learning courses on the Internet, have been obtained over the six editions of the ITAE course. Its first edition was in 1998 and since then, it has been run within the AulaNet environment.

The AulaNet and ITAE, which are developed in the same institution, create a platform where it is possible to collect data and make experiments while the participants work. It is possible to observe how participants interact with the environments, the content and among themselves, collecting and analyzing data that are naturally generated, such as messages, grades, discussion threads, contact information and self-reports. Some results obtained can be found in [18], [26] and [27].

The ITAE was developed for Web-based delivery. While, in principle, the development costs were significant, nevertheless most of the content was re-used in other editions, with the learners helping to improve it. The group of learners had to be limited to make their participation possible and to satisfactorily accompany them.

In ITAE, 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, and the participants have more time to reflect before composing their messages. In addition, besides the fact that extrovert personalities continue to send more messages than quieter members do, they cannot dominate completely as in face-to-face or synchronous situations. Quieter members still have the opportunity to contribute, as described by [28]. But 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 [29]. The instructors had to demand regular contributions in an appropriate timeframe to avoid dispersion.

The communication among the participants took on a fundamental role in the learning process through the exchange of information and points of view. It also interconnected the group and made it possible for the instructors to coordinate the activities and organize the participants, aiming for cooperation. Moreover, as described by [21], 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 effectively took place.

6. Acknowledgement

7. References

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