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Using a Group Support System to Meet Educational Objectives

Ricardo Choren   Hugo Fuks   Carlos J. P. de Lucena

Departamento de Informática

PONTIFÍCIA UNIVERSIDADE CATÓLICA DO RIO DE JANEIRO

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Ricardo Choren Hugo Fuks Carlos J. P. de Lucena

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Ricardo Choren
e-mail: choren@inf.puc-rio.br

Hugo Fuks
e-mail: hugo@inf.puc-rio.br

Carlos J. P. de Lucena
e-mail: lucena@inf.puc-rio.br

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Abstract: This work presents a WWW-based Group Support System (GSS) to facilitate the teaching/learning process. This work also describes our experiences over four successive editions of a pilot course offered using the GSS. We show the methodologies used and draw some results, experiences and impressions from this experience. We further describe planned future research, including discussion of the possibility of using this method to support distance education.

Keywords: cooperative learning, group support system, web, groupware, knowledge management.

Resumo: Este trabalho apresenta um sistema de suporte ao grupo (SSG) baseado na Web para facilitar o processo de ensino/aprendizagem. Este trabalho também descreve experiências sobre quatro edições sucessivas de um curso piloto oferecido através deste SSG. Nós mostramos as metodologias usadas e deduzimos alguns resultados, e impressões desta experiência. Nós ainda descrevemos a pesquisa futura, incluindo a discussão sobre a possibilidade de usar SSG como ferramenta na instrução da distância.

Palavras-chave: aprendizagem cooperativa, sistema de suporte ao grupo, web, groupware, gestão do conhecimento.

1. Introduction

"*The most important motive for study at school, at the university, and in life is the pleasure of working and thereby obtaining results that will serve the community.*" – Albert Einstein.

The society is changing, showing a fast and ongoing evolution in all the knowledge areas, more specifically in the technological area. This change affects the way people work and learn. More emphasis has been put on the inherent cooperative nature of business processes carried out by organizations composed of people [1, 3]. Lately, knowledge has been recognized as one of the most important assets of organizations.

It is common sense that a new type of worker will prevail in this new society¾the knowledge worker. The knowledge worker is able to work cooperatively and to learn new techniques and processes all the time. He will earn his living by using knowledge to create new knowledge [4], which is the wealth of these organizations.

As obvious as it may seem, starting from the belief that a group support system (GSS) should help individuals work together in a better effective way, it is perfectly possible to use a GSS for learning. Actually, GSS is uniquely suited to use as a teaching/learning tool because of the collaborative and interactive nature of the learning process. The hands-on approach helps people understand the requirements and benefits of these tools in a realistic setting, encouraging group interaction.

The remainder of this work is organized as follows: section 2 presents the motivation of using GSS for educational purposes. Section 3 describes the AulaNet GSS, showing its features, actors and services. Section 4 introduces the pilot course developed, describing how its methodology evolved during four semesters. Section 5 draws some results of the study with the pilot course. And, finally, section 6 discusses the current and the future work related to the system.

2. Motivation

"*We believe that the innovative application of C&IT holds out much promise for improving the quality, flexibility and effectiveness of education. The potential benefits will extend to, and affect the practice of, learning and teaching and research.*" – Dearing Report[†], 1997.

Academics have used e-mail to communicate with each other since the early 1980's. However it is only recently with the growth of the World Wide Web (WWW) and the explosion of the Internet that many lecturers and academic departments have started to fully exploit the potential of these technologies to enhance teaching [5].

The systems that have been developed as a consequence of using the Internet capabilities for teaching may be viewed as specialized group support system for education. They are designed to integrate and to be used as teaching and learning tools. These include conferencing software, e-mail, on-line resources, search engines and multi-media databases, video-conferencing, shared whiteboards and interactive simulations.

The main goal of using GSS technology in the educational process is to provide the student with a richer and more valuable educational experience than might otherwise be obtained [6]. This is based on the belief that education should be a multidimensional, multi-channel experience. In contrast, in the classic model of teaching, the student is viewed as an "empty container", and the role of the instructor is viewed as "pouring knowledge" into this container.

Much of this richer and valuable experience is obtained through interaction. A group support system [6, 7] provides full information support to members of a team who participate in one or more interactive processes or tasks. The goal of a GSS is to enhance the ways that people work, making them more productive. A GSS supports the individual work of each team member, as well as their cooperative work in various modes of interaction.

Since the educational process is defined and executed by groups, the aspects of communication, coordination and cooperation need to be addressed by a GSS. Specifically, from the group's perspective, such system needs to provide support for [8]:

- Communication, i.e., information exchange;
- Coordination, i.e., process definition, assessment and scheduling; and,
- Cooperation, i.e., working on shared tasks and accessing (manipulating) shared data concerning the course contents (documents).

A GSS, thus, should expand the traditional model of a teacher and a group of students interacting in a physical classroom, to an open model of a learning community, where instructors and learners interact to build a common (group) knowledge. A GSS can bring a number of benefits to the educational process, such as [9]:

- Enabling all participants to work simultaneously;
- Providing an equal opportunity for participation;
- Enabling groups to effectively bring more information, knowledge, and skills to bear on a task;
- Offering access to external information; and,
- Supporting the development of an organizational memory.

Having this in mind, AulaNet¾a GSS for creating, participating and managing distance courses¾is under development since June 1997 [10, 11]. The AulaNet approach is based on the cooperative work relations that happen during the learners' interactions with their instructors, peers and didactic contents.

3. The Aulanet

"*Groupware is one of those mysterious and undefinable terms that have the ability to affect all of our lives.*" – David Coleman‡, 1995.

AulaNet is a GSS for learning. To learn using AulaNet, a person has to share ideas (communicate), keep pace with the group (coordinate) and share workspace (cooperate). This means that AulaNet is not worried about translating the physical elements of the traditional classroom, such as blackboards, tables etc. AulaNet is more concerned about the interactive aspects of learning instead.

The actors involved in the learning process in AulaNet are the teacher, the learner and the administrator. The administrator acts in the system's daily operation, facilitating the integration between teachers and learners, through services such as the registration and enrollment. The administrator is also responsible for the maintenance of the system, i.e., interface customization, departments registration, system reports etc.

The learner is an "enhanced" classroom student. He must be active, just like while playing a video-game [10]. A GSS tears apart the bounds of the traditional school, and the learner has to take advantage of this. In a GSS he can participate much more, interacting with his peers and with the teachers, while in a classroom the student cross talk is forbidden, for instance.

The teacher is a "multi-functional" course leader. His main goal is to facilitate the learning process of the group, acting most of the time as a provoking/encouraging person. He can act as a course coordinator (when specifying the course structure and defining services), as a content provider (when preparing and uploading to the GSS the basic course contents) and as an instructor (when performing the course tasks with the group).

It is important to stress that AulaNet is not a content authoring system. The teacher–in the role of content provider–does not create any content using AulaNet. He creates the content using an external tool and uploads it into the system. There are no limitations related to the quantity or the format of didactic contents. A content is any "file" that can be displayed by a web-browser. The only exceptions are the exam tool (shown later in this work) and the data generated through meeting tools inside AulaNet.

3. 1. AulaNet Features

AulaNet is able to create and serve dynamic pages (HTML and whatever the browser can display), allows messages to be posted to conferences or to notice boards and maintains a database of information relating to users, learning contents and course structure. All these features are available within the system through the use of services. A service is a "complete component solution" to a feature provided by AulaNet.

The complete list of services provided by AulaNet complies:

3.1.1. E-mail (Contact with Instructor). A way to send e-mail messages to the course instructors. This is the basic communication tool between a learner and his instructor. A learner cannot contact another learner using this service.

3.1.2. Mailing list. This is an asynchronous text-based conference tool. It posts e-mail messages to all group members. All messages posted are sent to the electronic mailbox of all members and are stored in the environment for future reference.

3.1.3. Newsgroup. This is another asynchronous text-based conference tool. It stores the messages posted in a threaded discussion way, so that the members can track the discussion evolution.

3.1.4. Chat. This is a synchronous text-based conference tool, i.e., the synchronous meeting tool of the system. Here is the place where all the group members can join and exchange experiences at the same time.

3.1.5. Instant Messenger (Contact with Peers). This is a synchronous peer-to-peer communication tool. This tool offers the means for a member to get in touch (send messages) with another member who is currently online and also is on the course workspace.

3.1.6. Calendar. This is a basic scheduling tool. This tool aims to handle the basic time coordination of the group.

3.1.7. Assignment (Task). This is a task assignment tool. This tool allows instructors to create assignments for learners to complete as they work through course material. It should provide a means for learners to return completed assignments to the instructor for grading and feedback.

3.1.8. Assessment (Exam). This is an exam editor tool. This tool allows the creation of exams for learner (self-) evaluation. The system allows the instructor to create online exams to make a formative evaluation of the learning process, emphasizing the importance of the cognitive aspects of the learning process. The objectives of this tool are: to help the author in the creation of exams for a large audience, to give feedback to the learners, as well as to generate reports for the instructor [12].

3.1.9. Basic course flow (Lesson plan). This is a basic workflow tool. This tool is used to create the course lectures' initial structure-the lecture plan. A teacher prepares the didactic contents and organizes them into lectures. These lectures follow a suggested order, indicating a flow for the course. Notwithstanding, it is important to stress that:

- lectures indicate the main course subjects;
- contents of a lecture are scope delimited and constitute the main contents of the course; and,
- the flow (order) suggested by the teacher may not be followed by a learner.

The lecture plan does not operate as a traditional workflow, testing pre-conditions and triggering post-conditions since it might prevent a learner from building his knowledge, as he would want to. This service offers a skeleton but it does allow free navigation through the course lectures.

Each lecture comes with a tool for personal annotation or comments. At the moment, the data generated by this tool is not shared, i.e., only its owner can view it, but it may become a rich cooperation space.

3.1.10. Participation report. This is a participation-tracking tool. This tool facilitates the members' participation tracking in several course events and permits an appreciation of the quality of the contribution generated by this participation, from the instructor's point of view.

3.1.11. Co-authorship. This is a group dynamic cooperation tool. It allows an instructor to invite other instructors to input contents (multimedia resources) for the course.

3.1.12. Multimedia resources. These are the contents published into a course. In AulaNet, these resources can be:

- **Bibliography –** database with several types of bibliographic items. This tool is used to share information about specific references that the learners will use in their research;
- **Web reference –** A database with several links (URLs) external to the system. It serves to make use of contents provided by other educational sources in the course; and,
- **Documentation –** A document repository. This tool stores selected documents for online learner access.

3.1.13. Course outline. The course outline provides an overview of the course structure and may include methodology, syllabus etc. The system provides a template for the instructor to create the course outline.

3.1.14. File upload area (Learner co-authorship). For truly cooperative functionality, learners may not just be recipients of content uploaded onto the system by an instructor. They are able to upload their own contents for other participants to look at (depending upon instructors' approval).

4. Case study

"*Coming together is a beginning; keeping together is progress; working together is success.*"
– Henry Ford.

Since its release, back in 1997, there were many challenges posed to using a Web GSS to support the learning process. Thus, the AulaNet Team drove a case study to assess the usability of a GSS for learning. The central questions driving the studies were:

- Can a knowledge community exist in a distributed Web GSS?
- How can knowledge sharing can be supported?
- Is there a teaching methodology that can be "standardized"?

4. 1. Case description: the ITAE course

Information Technology Applied to Education (ITAE) is a graduate elective course of the Computer Science Department at PUC-Rio. This course introduces the students to the concepts of applying web-technology for educational purposes. Its goal is to learn how to learn with IT support, in order to train web-based educators.

The course was originally conceived to serve as a test bed for AulaNet. ITAE syllabus covers digital communication, groupware, web-based instruction, learningware, interactive multimedia and knowledge communities. The course had the goal of creating an ever-growing community about web-based instruction. The ITAE course was first given in the first semester of 1998 and its structure has suffered three methodology changes.

Initially, ITAE was a once a week face-to-face seminar. In this seminar, the instructor presented the lecture contents and this presentation was followed by a discussion session. This would sound just the same as the traditional classroom. The differences were that the presentation was recorded and the discussion was logged.

The recorded presentation and the discussion log were uploaded to the AulaNet system for anytime, anywhere consultation. Besides, AulaNet offered a communication support (e-mail, newsgroup etc) that was used to make a "post-class" discussion. So, AulaNet was basically used to avoid the notion of missing a class and to create an interactive stimulus among the group participants-the GSS was used only as a communication facility.

The second format of ITAE was a once a week face-to-face seminar and a once a week debate using chat. In this edition of ITAE, the course contents (documents) were those generated in its previous edition.

The face-to-face seminar was held not to present the lecture contents, but simply to make a discussion about it. Therefore, the group would have to go to AulaNet and check the lecture documents. The learners also had to access AulaNet to check the current and the upcoming course events-the GSS was used as communication facility, document repository and a simple coordination facility.

Yet, all the discussions generated new contents that were enriching the course contents. As a matter of fact, this second approach was created to make a smooth transition to the next approach used.

The third, and current, format of ITAE is totally held online using AulaNet. The course is an anytime participation with a once a week gathering session, all using chat. In this new structure, the course already has a basic content skeleton, composed by the contents created during its earlier editions. This shows the evolutionary aspect of a community generation, that is, there is a culture being passed ahead to the course cohorts.

The learners do everything online, from consuming the course contents to working with their peers through a mailing list, for instance. But, at the end of the semester, the members join for a "I really want to meet you" event.

4. 2. Third ITAE format dynamics

The next subsections describe the dynamics of the current ITAE format.

4.2.1. Enrollment and participation. The enrollment process was entirely done inside AulaNet. The course had no restrictions for the audience, allowing anyone to attend it. About participation, it is worth mentioning that, at first, AulaNet had no support for sub-groups (classes). Thus, every participant-learners and teachers-participated in an only big one group.

Later, AulaNet introduced the concept of classes. This allowed the division of the enrolled learners into smaller sub-groups, each one followed by an teacher (instructor).

4.2.2. Overall contents. The course overall contents comprise its name, description, syllabus, code, methodology, institution, department and a list of teachers (categorized in coordinators, content providers and instructors). The AulaNet interface shows the overall contents in the course startup screen, which also displays a remote control listing all the course services (generated by the mechanism selection) configured for ITAE.

4.2.3. Communication services. ITAE uses the following communication services: contact with the instructor, mailing list, newsgroup, chat and peer contact. In fact, the course uses all the communication services in the environment.

The teacher contact service is an e-mail tool, which serves as a hot line to reach a course teacher. In ITAE, this service is used to handle the learners' doubts concerning the didactic contents. The mailing list is where the presenter of the week posts the seminar and where the group discusses the subject. The chat is used to make a synchronous debate about the subject in discussion (this is, in fact, the weekly gathering of the group).

The newsgroup is used to develop the major topics of interest, selected among all the subjects of the course. At this phase, the group is split into subgroups. Each subgroup is in charge of a specific newsgroup, but all subgroups are required to participate in all other newsgroups. From these newsgroups, the participants build some contents that may be used to create a complementary lecture in the course.

Finally, the peer contact tool is used with no specific purpose in ITAE, allowing online group members to contact each other instantaneously (similar to products like ICQ and AOL Instant Messenger). For instance, an instructor can use it to call a leaner to have a more active participation in a chat session.

4.2.4. Coordination services. ITAE uses the following coordination services: scheduling, basic flow, learner contribution-track tool and task assessment. It does not use the exam assessment tool provided by AulaNet.

The scheduling tool is used like a billboard telling the group what, where and how are the upcoming course events. It is also used as a reminder of the course methodology. The task tool is the learning outcome assessment method. The course instructors give some tasks to be performed by a learner or a group of learners. The learners, then, are assessed according to their performance.

The basic flow tool is used to create the course lectures' initial structure. The course teachers prepare the didactic contents and divide them into lectures. These lectures follow a suggested order, indicating (just indicating) a flow for the course.

The learner contribution-track tool aids the instructor to assess the group through the contributions done throughout the course development. This is used as an informal assessment parameter.

4.2.5. Cooperation services. ITAE uses the following cooperation services: web reference, bibliography, documentation, teacher's co-authorship and instructor assignment. It does not use the download tool provided by AulaNet.

The web reference, bibliography and documentation mechanisms are used as other means of presenting didactic contents for the learners. A web reference links the course to a site outside the AulaNet environment. Documentation is a content similar to those used in a lecture (but not tied to the scope of a lecture subject). Bibliography is information about a textbook reference of the course.

The teacher co-authorship mechanism is used to allow other teachers to enrich the core contents provided in a course. The instructor assignment mechanism is useful since other teachers help dividing the class group into smaller subgroups resulting in more valuable learners' participation and in more elaborated didactic contents' creation. It is important to stress that a subgroup can have more than one instructor.

5. Results

"*Anyone who has never made a mistake has never tried anything new.*" – Albert Einstein.

After four semesters, ITAE has been under constant development, and some considerations were taken about the benefits as well as the limitations of using web technology in distance courses.

5. 1. Development cost

The time and the effort needed to develop attractive didactic contents and to animate a web-based course is, at first, substantial and possibly prohibitive. However, as ITAE is an incremental course over the time, most of the didactic contents is re-used, indicating a progressive reduction of its cost.

The cost of participating in the course, unfortunately, seems to keep constant, if not growing. Interaction demands attention, thus the teacher has to be an effective facilitator/instigator to promote the learning process at distance over the web.

5. 2. Learner participation

Despite some initial problems, caused by the learner's little experience with web-based education (and with AulaNet), the learners' participation was satisfactory.

The course methodology itself required intense learner participation, creating a learning environment with more cooperative experiences than the traditional classroom. The exposure introduced by AulaNet made the learners become more active.

5. 3. Group size and overload

The first two editions of ITAE had over 100 learners in a single class. This made it very difficult to create a cooperative learning environment with effective teacher facilitation and learner participation.

Since the course was based on a mailing list, hundreds of mails were posted during a week, making it really hard to read most of them before the synchronous debate session. This communication overload required group subdivision, with each subgroup having its own instructor (facilitator teacher).

From the third edition of the course on, each group had a range of 20 to 25 learners. Without communication overload, the quality of the learners' contributions increased, given that all the learners were able to effectively participate and to aggregate value to all the contributions posted.

5. 4. Learning outcomes

The learners' assessment in ITAE is done through the contributions made all through the course and through the creation of a didactic content about the subject of the newsgroup the learner participated in.

In fact, AulaNet has an assessment tool that was not used in ITAE as well because it was important to assess the learners as a group. Thus, the teachers have been trying to involve the learners in a group project where they can be exposed to different situations, instead of translating a conventional assessment task to the web.

To evaluate a contribution might turn into an arduous task. The teacher needs to measure the group as a thermometer. In ITAE, the teachers are aided by the group comments about a contribution, that is, the group (participating actively) usually indicates if the contribution is really significant.

5. 5. Questioning considerations

The findings of case study provide encouragement for the view that knowledge communities can be sustained in distributed Web GSS environments. However, these communities do not entirely feel comfortable to participate in a learning group without having a "physical contact". All the groups were formed by the beginning of the semester and we have no data about the legitimization of newcomers, who had no previous domain knowledge. The GSS must provide an easy integration of new participants so that the community shall not fall apart.

Knowledge sharing was basically seen when using the communication services. It is our cultural inheritance to think that we learn just for ourselves and that is what should be taken into account. A GSS offers valuable spaces for sharing but the participants must be willing to share. We have seen in these cases that some participants just spent all the time hidden, while others communicated a lot.

About a teaching methodology, what can we say? How should a learning process be done, using a GSS, so that the participants take the best of this experience? We do not know. The study used three different methodologies and, for each one, we will find participants who feel very comfortable to learn in such a way. It is clear that further data is needed regarding the profits brought by a specific teaching methodology when participating in a distance course using a GSS.

5. 6. Other considerations

There are some other considerations that we have pointed through the development of ITAE, including:

- Copyright issues;
- Learner misbehavior;
- Technical difficulties, specially about the use of plug-ins to some contents; and,
- Some environment limitations.

6. Some conclusion and future work

"*Okay, brain. You don't like me, and I don't like you, but let's get through this thing.*" – Homer Simpson.

Recently, there have been many research and development efforts on creating learning environments using GSS. The basic approach taken is to integrate some communication and cooperation features to offer spaces for active and cooperative learning.

The use of a GSS is seen as relevant both to enhance learner-learner interaction and to reinforce learning. In a traditional classroom, a student is not allowed to interact with his peers, but only with the instructor (in a passive instructor-student direction).

Another remarkably important goal of using a GSS is concerned about the course contents. Typically, the instructor alone generates the course contents previously to the course period. A GSS provides ways for the learners to make contributions to the course contents, constantly aggregating value to them.

For short, the advantages of using GSS for learning include: creation of learning environments; life-long learning; educational variety and choices; just in time learning; change of roles and change of responsibilities. On the other hand, GSS shows some limitations, such as: bandwidth; performance; functionality; flexibility; reliability; good people and time.

Usually, three aspects of GSS can be applied to a cooperative process: communication, coordination and cooperation. In the following, there is a summary of the GSS presented in this paper, looking at each of its communication, coordination and cooperation aspects.

6. 1. Communication aspects

The GSS presented makes use of communication channels to improve interaction between course participants. The communication tools are mostly asynchronous using e-mail. There is also a chat tool for synchronous debate.

Some communication aspects (mainly informal) shall yet be handled. A mean of informal communication that is not explored in the AulaNet is the use of shared documents like "post it". A participant would be able to leave messages in the environment for just one other participant (or a specific subgroup).

6. 2. Coordination aspects

AulaNet provides simple coordination through a scheduling tool. The system also provides a competency coordination tool using assignments (exams). In order to allow free participants' interaction, the system does not make use of a workflow tool (used mainly in strictly coordinated processes).

However, the coordination mechanisms may need to provide more moderated and end-user-controlled amount of automatic coordination. Chat moderation (e.g. floor control) and awareness information can be valuable meta-information to participants cooperatively executing a process.

A process space schema is another feature that can enhance the coordination in AulaNet. Although the navigation is taken for granted to be free, some sub-processes, such as, assignment resolution, may require specific coordination for a sub-group, defining a process space within the course main space.

6. 3. Cooperation aspects

The AulaNet cooperation [13] features, such as, shared information space (e.g. bibliography, documentation) and co-authorship provide a good ground for executing a cooperative learning process. These features allow groups to cooperate basically asynchronously. For a synchronous cooperation execution (group dynamics) it would be desirable that the AulaNet provided activity spaces.

Activity spaces are spaces for hands-on group learning experiences that, coupled with the file upload area, let a learner aggregate value to the process. These spaces are created and possibly destroyed (and coordinated through process space schemas) by the participants during the course execution. These spaces may also be valuable for learner assessment purposes, showing the learner progress during the execution of a task.

6. 4. The aim

The short-term goal of the AulaNet system is to show the worth of using GSS technology for supporting cooperative educational processes, instead of creating a traditional-translated educational environment. The system is continually adapted and enhanced. It is used at our university (which now has a Distance Education Center), it is freeware and has already been downloaded by other 2000 organizations (mostly educational).

This paper showed a course that is an example of the system usage at our university. This example was planned and executed by the AulaNet research and development team. The next step is to gain more usage experience in order to make a survey about the system utilization in other organizations. This step is important to create larger communities of AulaNet users communities.

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