

## **Extending Collaborative Learning Coordination Support in the AulaNet LMS using mobile devices**

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In order to follow a discussion in a forum, mediators and learners must check conference development regularly once it is not possible to know when other participants will send their messages. Forum mediators, particularly, must be in attendance on discussion progress even more promptly to promote quality learner participation in the discussion as well as intervene if necessary. Mediators also need to collect and analyze data to follow the development of the discussion and learners' participation. This work presents an extension of the desktop AulaNet web-based learning environment for mobile devices developed to evaluate coordination tools for learners and mediators of educational forums.

**Keywords** Collaborative learning, CSCL, forum coordination, m-learning

### **1. Introduction**

The forum or conference is a textual asynchronous communication tool that is used for the discussion of a course topic. In order for the conference to reach its purpose, support for the coordination of learner activities is necessary. Mediators must perform the tasks of preparation, accompaniment and evaluation of the discussion. They must also maintain continuous monitoring over the entire running of the conference, ensuring that learners participate with quality arguments, and intervening promptly when problems happen. Learners also must organize themselves to carry out their tasks and comply with certain obligations [1] such as, for example, sending a minimum number of messages, presenting a position on a given topic and meeting deadlines.

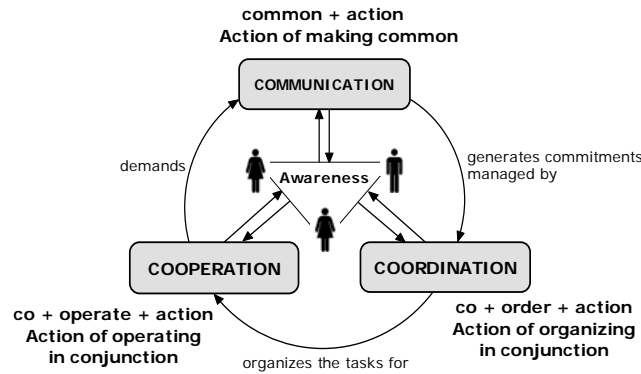
As the contributions may occur at any time and at any rate, participants need to connect frequently to the environment to verify the course of the discussion. In the specific case of mediators, another difficulty is the frequent need to collect and analyse data to follow participants' activities. This study investigates the use of mobile technology in collaborative learning as a way of helping participants of a conference to coordinate their activities. For this purpose, this paper also presents the extension of the AulaNet LMS Conference service for PDAs and cell phones.

In section 2, coordination is approached as an element of collaboration. Section 3 presents tools for forum coordination support and the AulaNet LMS extension for mobile devices that implements these tools. Section 4 concludes the article.

### **2. Coordination for Collaboration**

In order to collaborate, members of a group must communicate, coordinate themselves and cooperate. While communicating, they negotiate and make decisions. While coordinating, they deal with conflicts and organize the group in a manner that prevents the loss of communication and cooperation efforts. While cooperating, they work together in a shared space, seeking to complete tasks, and generating and manipulating cooperation objects [2]. The need to renegotiate and to make decisions about unexpected situations that appear during cooperation and demand a new round of communication, which in turn will require coordination to reorganize the tasks to be executed during cooperation. Finally, members of a group need to be aware of the progress of activities through information offered by the environment. The 3C Collaboration Model summarizes this cycle (Figure 1). This model, initially proposed by Ellis, Gibbs

and Rein [3], is used to guide the specification and analysis of new AulaNet services and functionalities and to review trial outcomes. This paper focuses on the coordination aspect of collaboration.



**Fig. 1** Diagram of the 3C Collaboration Model.

Coordination organizes the group in a manner that prevents loss of communication and cooperation efforts and ensures that tasks are carried out in the correct order, at the right time and in compliance with existing restrictions and objectives. Artifacts such as schedule tables, checklists and service orders are used by group participants for coordination [4], which is also accomplished through rules and highly defined protocols, or through the social protocol. Without coordination there is a risk of misunderstandings, disorientation, conflict and duplication of tasks.

Awareness is important for coordination. Through the awareness of how the group is working, participants can evaluate the quality of their work and better focus their actions. For learners in a forum it is interesting to know, for instance, if the conference has already began, which messages have already been appraised and if there are new ones to be replied to. Mediators have different objectives and need information that present a deepened vision of the conference. They need to know, for instance, who is not participating adequately, if there are messages that harm the discussion and if deadlines are being met.

Although they are important, these bits of information on the progress of activities cannot be excessive. One way of avoiding this problem is using reports, graphs and statistics that summarize and offer a general vision of the discussion. Activity reports and a history of the participation of individual learners are tools that already exist in some groupware applications [5][6][7][8]. Statistical data about the conference is frequently presented along with data related to other services of the LMS, and in some cases, specific reports are made available for each conference. Using interaction analysis in LMSs helps to identify, for example, subgroups of learners who debate only among themselves. Another coordination tool consists of sending e-mails notifying the occurrence of given events [9]. Nowadays the widespread use of cellular phones and the ubiquitous character of this device have given rise to the appearance of several applications that send alerts through SMS messages such as warnings about credit card transactions and computer network monitoring [10]. In education, warnings are sent through SMS to inform, for instance, about changes in activities, proximity of deadlines, and student and teacher performance [11][12]. In the case of this paper specific SMS alerts for following up conferences are investigated.

### 3. Tools for conference coordination in AulaNet LMS

The AulaNet is a web-based LMS that has been developed since June 1997 by the Software Engineering Laboratory of the Catholic University of Rio de Janeiro (PUC-Rio). The AulaNet is a freeware application used in many universities and companies in Brazil and abroad. The investigation of tools that can offer continuing support to conference participants is being conducted concomitantly with the development of AulaNetM, the extension of AulaNet Conference service for mobile devices. These tools consist

of graphs, charts, statistical data and alerts presented to learners and mediators through PDAs and cell phones.

Gerosa, Pimentel, Fuks e Lucena [2] propose as a coordination tool for mediators the offering of the presentation of the conference structure in a fully visual manner and graphs and charts presenting statistical data about the conference. In a conference several discussion lines are created where the relationship between a given message and the message it is replying to is visually characterized. As the messages are published and remain in the environment, one can have a visual indicator of the direction a discussion is taking. Depending upon the characteristics of the structure formed by the chaining of messages, mediators can evaluate at a glance if an excessive deepening of a certain topic of the discussion is taking place, lack of dialogue among learners and difficulty in debating a subject [2]. Graphs with information such as message size, date and category also aid mediators in evaluating the development of the conference. For instance, a graph that shows a very high percentile of messages classified as "counter-argument" indicates that a strong confrontation of ideas is taking place in the conference. A graph that reports the number of messages sent by learners reveals which ones are not participating frequently enough. Even without reading the messages, mediators identify, through the structure of the conference and the graphs, if there are potentially problematic situations that demand their intervention.

In light of this, AulaNetM offers mediators the visualization of conference structures and charts about the conference. Number of messages sent by each participant, percentage of messages without replies and number of messages sent per hour during the conference are examples of data presented to mediators (Figure 2). The use of wirelessly connected PDAs presenting data in a statistical and visual form increases the number of opportunities for mediators to access the environment to verify whether they have to intervene in the conference. This concise and summarized information is suitable for quick consultation checks during short periods of time, such as a coffee break or while waiting for a meeting. Case studies indicate that the visual rendering of the conference structure, coupled with PDA mobility, is a useful coordination tool for mediators [13].



Fig. 2 Example of conference message list, conference structure and charts in AulaNetM.

AulaNetM also sends alerts to participants about the progress of the conference (Figure 3). In the case of mediators, AulaNetM triggers alerts when situations that break the conference's pattern have been detected. These situations are identified when they deviate from the patterns observed in previous course editions. Six alerts have already been implemented, such as lack of conference activity, very low participation by a given learner or messages categorized as "Questions" that have received very few answers. The alerts are received through PDAs and SMS messages.



**Fig. 3** Example of alerts in AulaNetM.

Mediators and learners receive SMS alerts regarding the activities of the conferences. This research took into account alerts that favored the group and not a particular individual, avoiding alerts such as “your message has received a reply” or “your message has been evaluated”. The alerts inform that a given number of messages have been sent or that a given number of messages have been evaluated. Without more detailed information about the new messages and assessments, learners are expected to access the conference to check if any of these interest them. A case study in the Information Technology Applied to Education course offered by the Catholic University indicated that, with SMS alerts, conference accesses became more effective as the number of situations in which participants accessed the conference and didn't find new messages or evaluations decreased[14].

#### 4. Conclusion

The development and implementation of this work has shown in practice the difficulties of using and adapting an application to a mobile environment. The more restricted configuration of mobile devices, particularly their screen size, and the constant possibility of disconnection while moving around with PDAs, do not allow resources to be used indiscriminately by the application. In practice this means that users' demands should be met quickly with concise, precise and focused answers. One way of reaching these objectives is using visual and statistical information as proposed here. Even without reading the conference messages, the information presented warns of problematic situations and gives a general notion of the conference. Thus, the use of mobile devices to present information that can be consumed in short periods of time, anytime, increases the opportunities for participants to follow up conferences and to act when necessary.

AulaNetM began with the proposal of offering a version with all the functionalities of the desktop AulaNet Conference Service, but the first versions of the new service demonstrated that it was more relevant to explore functionalities that are appropriate to mobile devices and the situations in which they are used. In this context, support to conference coordination was identified as an important function.

The availability of functionalities in cell phones and PDAs for mediators, and just cell phones for learners, satisfied the different affordances and constraints. PDAs satisfy the greater demand of mediators for more elaborate features such as those that display charts and the tree structure, while the latter satisfy the demand for just-in-time information.

**Acknowledgements** The AulaNet project is partially financed by Fundação Padre Leonel Franca and by the Ministry of Science and Technology through its Program Multi-Agent Systems for Software Engineering Project grant nº

552068/2002-0. It is also financed by individual grants awarded by the National Research Council to: Carlos José Pereira de Lucena nº300091/2003-6, Hugo Fuks nº301917/2005-1.

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