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Intelligent assistance for teachers in collaborative e-learning environments

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ABSTRACT

Collaborative learning environments provide a set of tools for students acting in groups to interact and accomplish an assigned task. In this kind of systems, students are free to express and communicate with each other, which usually lead to collaboration and communication problems that may require the intervention of a teacher. In this article, we introduce an intelligent agent approach to assist teachers through monitoring participations made by students within a collaborative distance learning environment, detecting conflictive situations in which a teacher's intervention may be necessary. High precision rates achieved on conflict detection scenarios suggest great potential for the application of the proposed rule-based approach for providing personalized assistance to teachers during the development of group works.

1. Introduction

The great progress achieved in communication possibilities through information networks like the Internet, along with the development of numerous distance learning systems (Gilbert & Han, 1999; Papanikolaou & Grigoriadou, 2003; Peña, Marzo, & de la Rosa, 2003), has given place to the improvement of teaching and learning processes (Akhtar & Wyne, 2006). The basic idea of these systems is that teachers and students placed in different geographic places, can interact and achieve the learning process in a non-present way (Offir, Lev, & Bezalel, 2008), offering the continuous education of people who, for diverse reasons, are not able to attend to regular courses.

The technological development and the efforts addressed to improve education have contributed to convert distance learning platforms into a very interesting field for computer researchers and software engineers (Littlejohn, Falconer, & Mcgill, 2008). As these systems are used by different kinds of students with diverse abilities and preferences, the main desired characteristics for them are adaptability and personalization (Alrifai, Dolog, & Nejdl, 2006; Schiaffino & Amandi, 2004).

Besides the individual work a student can carry out using an e-learning platform, it is important to take into account the development of group works carried out in collaboration with other peers (Wessner & Pfister, 2001). Collaboration stimulates learning, increases motivation, promotes feelings of belonging to a team, encourages creativity, eases communication and increases the achieved personal satisfaction for the educative process (Plantamura, Roselli, & Rossano, 2004).

When using a virtual collaborative work environment, the basic interaction mechanism students have to collaborate with their peers is through proposals and counter-proposals within a structured discussion. A structured discussion consists in a workspace similar to a forum in which students can make proposals and vote based on fixed topics. In this case, these topics are the tasks proposed by the teacher for the collaborative work. Communication is asynchronous, that is to say, users communicate through messages that can differ considerably in time and space. Once the discussion about the way tasks are going to be performed is finished, students can edit their collaborative work in a Wiki-like[1] environment.

A student that proposes a way to face the solution of a problem usually finds three kinds of answers: (1) the acceptance from their peers, implying the development of the activity in the way that was suggested; (2) the counterpart is rejection, a member of the group does not agree with the suggestion enabling the possibility of presenting another alternative or continuing with the original proposal; and (3) a third possibility, that usually comes attached to a rejection, is the counter-proposal, meaning that there is a disagreement with the original idea, but an alternate way to face the problem is suggested. This last alternative is the most broadening, since it encourages communication and

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[1] A Wiki is a piece of software that allows multiple authors to edit web page content.

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enables cross fertilization of ideas (Constantino Gonzalez, Suthers, & Escamila de los Santos, 2003). In this way, students in the same group can interact until they arrive to a solution for the proposed problem. It can also appear a fourth possibility known as indifference, that is, the non-participation in discussions.

Even though students have freedom to express and communicate without restrictions, the idea of supervision emerges naturally (Kosba, Dimitrova, & Boyle, 2007). Thus, teachers have the possibility to intervene whenever they consider it necessary, helping the regular course of the activities. Particularly, the approach discussed in this article focuses on providing assistance to teachers for fostering the development of the activities within groups (starting from the student's behavior in that group as well as in other group works with different mates, alerting them about conflictive situations) so that teachers can intervene in the cases they consider it necessary. In this work we used an approach based on intelligent agents, which combines both conflict detection and assistance to the human teacher through alerts.

The remaining of the article is organized as follows: the following section focuses on our approach of intelligent assistance for teachers on e-learning environments, explaining some basic concepts related to Computer Supported Collaborative Work (CSCW) applied to distance learning platforms and intelligent assistance. In Section 3 we explain how we materialized our approach, focusing on students' profiles, conflict detection and alert notifications. Then, in Section 4 we show the experimental results obtained using this approach. Section 5 summarizes some related works. Finally, concluding remarks are stated in Section 6.

2. Intelligent assistance approach

Computer Supported Collaborative Work (CSCW) systems provide the necessary support in the use of communication services for sharing information and finding appropriate users to collaborate (Mandviwalla & Grillo, 1994). E-learning technologies are effective if they are conceived and used with the express purpose of promoting learning and collaboration (Kligyte & Leinonen, 2001), focusing in groups' dynamics and in group-based activities to facilitate learning (Soller, Goodman, Linton, & Gaimari, 1998). However, building a group is not enough for students to collaborate (Qu & Nejdl, 2001). Effective collaboration involves a set of conversational skills to motivate, inform and require knowledge (Soller, Lesgold, Linton, & Goodwin, 1999). These abilities acquire special importance in virtual learning environments where students are not able to meet face to face (Ayala & Yano, 1996). Hence, to achieve an effective collaboration, it is necessary to know which of these abilities students intervening in a learning community have and which they have not, as a means to personalize learning experiences in collaborative environments.

Web based e-learning platforms provide the appropriate support to develop such collaboration approach, especially through shared workspaces, Wiki edition and other communication tools, such as forums and chats, where group members can exchange ideas and make progresses in developing activities collaboratively (Sheremetov & Guzmán Arenas, 2002). In the context of collaborative environments explained before, teachers play a fundamental role in the learning process, having to guide the groups in their activities and in the communication among members. In this scenario, the idea of assistance comes up naturally, not only for the students, but also for the teachers in charge of courses and works (Kosba et al., 2007).

In traditional distance learning platforms, a teacher may be able to control the activities and collaboration of a particular group or student by manually browsing their interactions. This approach is known as "control board", after its similarity with a human operator monitoring a machine. This is an extremely difficult, repetitive and time consuming task, since teachers have to considerate all individual groups and students, being particularly careful with some cases in which their expertise and intuition tell them about a possible collaboration problem. Following the same analogy as before, this problem might be tackled with the existence of some kind of "secretary" or "assistant" helping them to perform this task. That is to say, if the system could be able to learn the teachers' knowledge on detecting problems instead of having to inspect them manually, it can automatically warn them about conflictive cases. Needless to say, the second approach would be dramatically more convenient for teachers, relieving them from a lot of tedious and monotonous work.

Intelligent assistance is a very promising research field of the Artificial Intelligence (AI) area (Lieberman, 1997; Schiaffino & Amandi, 2004), that is being quickly adopted by commercial software applications. Interface agents are computer programs that provide personalized assistance to users dealing with computer based applications (Jennings, Sycara, & Wooldridge, 1998). Regular tasks or control board interfaces can be successfully replaced by enhanced assistant-like user interfaces that politely warn the user about something that is going on in the application or suggest a possible way to proceed given a certain state in the execution.

The goal of our approach is the materialization of an intelligent interface agent, capable of providing the teacher with the necessary assistance to supervise and detect conflictive cases in collaborative works that are being carried out during the development of a course, giving an appropriate alert, so that the teacher can intervene when he or she considers it convenient. Fig. 1 shows a sample snapshot of the distance learning system uses in this work and the agent alerting the teacher about a collaboration conflict within the interface.

To assist teachers effectively, the proposed collaborative work interface agent has to be capable of providing them with a summary of the individual progress of each group member, which could be an indicator of the level of knowledge about topics of the course, and the type of participations students have had in their work groups, that is to say, the amount and quality of their proposes, acceptances, rejections, counter-proposals, or simply, an indifference attitude before ongoing discussions. Additionally, the agent counts with information about the Learning Style test of each student (Felder & Brent, 2005; Felder & Silverman, 1988), which defines their learning mechanism in four categories, considering both extremes for each case: intuitive/sensitive, sequential/global, active/reflexive and visual/verbal. Student's learning style can be defined by a standard test[2] taken by each student before starting their activities, or detected by the system based on the student's interactions (Garcia, Amandi, Schiaffino, & Campo, 2007).

If the characteristics of the action plan defined for a work and the tasks being held in a group do not match with the learning style of one or more students, this can influence negatively and has to be taken into account to notify the teacher. Considering this information about the particular learning style of each student, the global performance of a group, the attitude of each group member before the proposed work, the student's profile of behavior in that particular group and the history of attitudes of the student in other collaborative works, human teachers may receive alert messages from the agent, having to decide if they want to intervene and in which fashion, always trying to improve the accomplishment of the proposed activities as well as changing negative attitudes from one or more group members.

[2] http://www.engr.ncsu.edu/learningstyles/ilsweb.html.