

A Collaborative Editor for Medical Learning Environments

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INTRODUCTION

Collaborative learning is changing the learning environments design. Intelligent tutoring systems (ITS), multiagent systems, affective computing, and virtual characters, are techniques and resources to improve individual and personalized learning.

ITS and ILE (intelligent learning environments) try to adapt to the characteristics of each student through the construction and the analysis of models that reflect both behavioral and cognitive aspects of the students. These systems represent more advanced pedagogical tools and provide more individualized learning experiences.

However, even with all the sophistication of these systems, cases can occur where the course material given by them is not sufficient to supply pedagogical necessities that a student comes to acquire during one learning activity. In these cases, is important to have tools that allow human-human interactions, where students can communicate themselves with tutors, or other students, and can jointly supply necessities and construct knowledge.

The importance of social interactions in the learning process is already known by the educational theoreticians. Some studies in this field are the Socio-Cultural approach of Vygostky (1999); some works of Piaget (1995); theories of Collaborative Learning (Dillenbourg, Baker, Blaye, & O'Malley, 1995); and others.

Recent advances in the ITS and ILE fields have proposed the use of agent's society-based architectures (Norman & Jennings, 2000). The principles of multiagent systems have showed a very adequate potential in the development of teaching systems due to the fact that the nature of teaching-learning problems is more easily solved in a collaborative way.

The collaborative learning systems development takes into account social factors, like those presented in

Vassileva's and Cao's work (Cao, Sharifi, Upadrashta, & Vassileva, 2003). They concluded that is very important to consider sociological aspects of cooperation and to discover and describe existing relationships among people, existing organizational structures, and incentives for collaborative action. Hence, the learning environment can detect and solves some conflicts, help to perform tasks, and motivate learning and collaboration.

Based on presented ideas, our research group has been developing some intelligent learning environments to promote collaborative learning. The AMPLIA environment (Vicari et al., 2003) is a multiagent system that provides a collaborative Bayesian Net Editor to allow students build their own networks and compare them with the expert network. This collaborative construction happens between medical students.

This article presents the social agent that acts in the AMPLIA's collaborative editor in order to improve collaboration. AMPLIA is an intelligent probabilistic multiagent environment to support the diagnostic reasoning development and the diagnostic hypotheses modeling of domains with complex and uncertain knowledge, like the medical area. The social agent supports group formation and it makes a search among students of an ITS/ILE looking for suitable students to join in a workgroup. Hence, students can help others during a common learning task. For such, these agents takes into account some affective and social aspects of the students.

RELATED WORK

The group dynamic has been addressed by many researches and in different areas. The multiagent approach is adjusted to the problem of group formation and coordination.

Vassileva's (2001) research is about strategies and techniques of groups. Cheng and Vassileva (2005) proposed a motivation strategy for user participation based on persuasion theories of social psychology. In Cao et al. (2003), the goal is finding out how people develop attitudes of liking or disliking other people when interacting in a CSCW (computer supported cooperative work) environment in a collaborative-competitive situation, how they change their attitudes towards others when they realize their attitudes towards themselves, and how the design of the environment influences the emergent social fabric of the group.

A Bayesian network-based appraisal model was used by Conati (2002) to deduce a student's emotional state based on his or her actions.

Individuals' affective states have significant importance in the interaction process. For Scherer (2000), the affective states are divided in five categories: *Emotion* (episode related to synchronized responses for all or most organic systems to the evaluation of an external or internal event: anger, sadness, joy, fear, shame, pride, elation, and desperation); *Mood* (diffuse affective state that consists of the subjective feeling changing, with low intensity, but long duration, without apparent cause); *Interpersonal Stances* (affective position in relation to the other person in a specific interaction, such as distant, cold, warm, supportive, and contemptuous); *Attitudes* (attitudes are relatively tolerant, affectively colored beliefs, preferences, and predisposition in relation to objects or people, such as liking, loving, hating, desiring, and valuing); and *Personality Traits* (emotionally laden, stable personality dispositions and behavior tendencies, typical of a person, such as nervous, anxious, reckless, morose, hostile, envious, and jealous).

The social agent, described in this article, is based on social psychology ideas (to support social aspects) and affective states.

Most of medical software related to our application use knowledge-based models, while AMPLIA is a medical software that can be used for education purposes that considers cognitive and social states to build the student model, following an epistemological theory. Other medical software used for education purposes are Promedas (<http://www.promedas.nl/>), BioWorld (<http://citeseer.ist.psu.edu/lajoie95establishing.html>), Medikus (Möbus, 1995), and COMET (<http://www.cs.ait.ac.th/~haddawy/pubs/iui04.pdf>). Besides the knowledge-based model, BioWorld considers the self-confidence level. However, the strategies used in these

systems do not consider interactions between user and system based on cognitive models neither consider group interactions or group models.

INTELLIGENT PROBABILISTIC MULTI-AGENT ENVIRONMENT

AMPLIA is an intelligent multiagent learning environment designed to support training of diagnostic reasoning and modeling of domains with complex and uncertain knowledge (Vicari et al., 2003). AMPLIA focuses on the medical area. It is a system that deals with uncertainty under the Bayesian network approach, where learner-modeling tasks will consist of creating a Bayesian Net for a problem that the system will present. The construction of a network involves qualitative and quantitative aspects. The qualitative part concerns the network topology, that is, causal relations among the domain variables. After it is ready, the quantitative part is specified. It is composed of the distribution of conditional probability of the variables represented.

A negotiation process (managed by an intelligent *MediatorAgent*) will treat the differences of topology and probability distribution between the learner model built and the one built-in in the system. That negotiation process occurs between the agents that represent the expert knowledge domain (*DomainAgent*) and the agent that represents the learner knowledge (*LearnerAgent*). The *Social Agent* interacts with *Learner Agent* to suggest which classmate is recommended to work together with him or her. It also interacts with *Mediator Agent* that knows the domain and supports the negotiation process. All *Social Agent's* suggestions are sent to online students by chat tool.

The AMPLIA's pedagogical design was based on Piaget's (1995) and Vygostky's (1999) theories in order to support constructivist knowledge construction. In addition, the AMPLIA's Net Editor (see Figure 1) was designed as a collaborative editor to allow collaborative learning. Thus, the diagnostics hypotheses can be built by workgroups and, after all, can be compared with the expert network.

The collaborative editor is watched by the social agent, which main goal is improve student's learning stimulating his interaction with other students, tutors and professors. At AMPLIA, each user builds his/her own Bayesian Net for a specific pathology. The Bayesian Net corresponds to the student model for a particular problem solution in the health context. During this

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