

Cooking a Socially Intelligent Tutoring Platform

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Educational technology has moved from tools that automate repetitive tasks such as grading tests to intelligent tools that provide personalized instruction. Intelligent tutoring systems give direct one-on-one instruction and feedback to students during problem solving. Students, however, often engage in off-task behaviors that diminish learning gains. Maintaining sustained student motivation is therefore important for effective learning, yet providing motivational feedback is often at odds with cognitive scaffolding. Various approaches for improving motivation have been proposed. The affective support for learning seems difficult to realize and therefore remains limited, while the narrative-centered story-based approaches are not directly applicable to traditional domains such as mathematics and computer science.

In this work, we propose to enhance computer-supported learning systems with a virtual conversational agent that employs socially intelligent dialog strategy to increase student motivation and guide students to instructional activities appropriate for their current context [1]. The activities (problem solving, course notes) are augmented by social features (synchronous group work, annotations, asynchronous discussions, etc) which are subsequently used by the tutoring agent to facilitate a socially encouraging learning path for individual students (Figure 1). The dialog strategy is induced by reinforcement learning method on Wizard-of-Oz natural language data collected online with the help of domain experts.

The tutoring agent does not directly participate in learning activities with students and its dialog capability can be developed separately from the domain content. In the process, we redesigned numerous techniques used in pseudo-tutor learning environments and tailored them to the socially intelligent tutoring context. The problems for students to solve are scripted in a template language that generates complex problems with hints, while optionally being semantically adapted to student's individual preferences. Decisions are made on the server, natural language dialogs and collaborative features within the client's interface are synchronized near real time.

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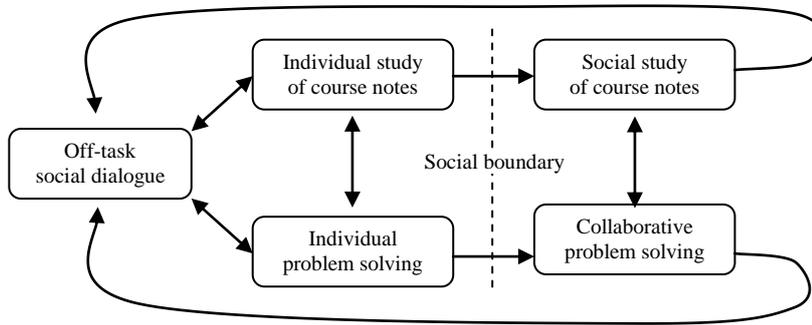


Fig. 1. Types of learning opportunities with admissible transitions (arrows), which are facilitated by the tutoring agent.

In present state of the platform, the tutoring agent influences the transitions between different learning activities by a set of rules that can recommend a good course of action for the student at any given moment. For example, when an examination is imminent, the student is advised to work on exercises from a similar problem set. When a student (or a collaborative group of students) does not seem to understand the most basic of facts during problem solving, she (or the whole group) is redirected to the corresponding course material. Rules for facilitating the transitions get more involved when the social boundary is crossed (Figure 1), as other people are a valuable resource with which the tutoring agent can “negotiate”. It is not possible for a human student to cross this boundary at will, and the transition *must* be facilitated by the tutoring agent. For example, when a student repeatedly demonstrates incompetent behavior (in terms of social/task abilities) the tutoring agent can refuse to put him in a group that would probably only impair the work of others due to his unfit behavior.

We apply these methods to increase motivation and learning gains in a learning system for middle school mathematics. Some 54% of students engage with the tutor quite naturally, while the others seem to require more tangible benefits. Students in the socially engaged group liked the system and the tutor more, and they were also more successful in solving problems within the tutoring environment. The reinforcement learning strategy lets us create a working dialogue capability rapidly, without tedious dialogue scripting. We envision that advanced users (students and teachers) can put expertise in their own virtual presence, adding new virtual tutors capable to directly help others in learning.

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References

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