

Enhancing ITS instruction with integrated assessments of learner mood, motivation and gender

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Abstract. ITS instruction may be enhanced by models of student motivation and mood, in addition to cognitive skills and domain knowledge. In an initial study, self-assessments by high school students of their mathematics motivation and mood showed gender differences in response to ITS instruction, and predicted students' intention to learn from the ITS and use of multimedia help features.

Introduction

Much recent research points to the important role of student motivation in learning. Students who are highly motivated set goals, monitor their progress, evaluate their understanding, and use strategies to enhance learning, and have higher grades and test scores than less-motivated students. In fact, behaviors associated with high motivation are a stronger predictor of academic learning outcomes in some studies than measures of general intelligence [1]. Thus, adding a model of learner motivation should increase the pedagogical effectiveness of ITS instruction.

1. Project objectives

In this poster, we present our initial efforts to assess students' motivation and mood while working with an ITS. Self reports provided a reliable, non-intrusive and inexpensive source of motivation and mood data that could be easily collected in public school classrooms. Our initial target domain is high school mathematics, specifically, instruction in problem solving for high stakes achievement tests in the Wayang-West ITS. We were especially interested in the interaction of student gender and motivation. Much prior research indicates that females and males have different emotional reactions in mathematics, and that females have higher levels of test anxiety. Although females receive higher grades on average than males in math classes, females tend to score lower on high stakes achievement tests such as the SAT-M [2].

2. Study methodology

2.1 Participants. The study included students ($N = 47$) in two high school geometry classes in a large high school in urban Southern California serving a diverse student population. Students worked with the Wayang-West ITS during their mathematics class each day over one-week period, under the supervision of their classroom teacher.

2.2 Instruments. The Wayang-West ITS included integrated web pages at which students completed their daily "Math Personality Profile" (MPP). The MPP included instruments to assess a) beliefs about intelligence (fixed or possible to enhance), b) mood (anxious or relaxed/confident about the activity), c) mathematics motivation (self efficacy, liking of math, value of math), d) expected performance (predicted score on a real exam), e) intention to learn from the activity (attention, effort) and f) attribution for quality of the day's math work.

3. Results and discussion

Student motivation. Not surprisingly, students who had high self efficacy in math before the ITS intervention had higher expectations for success, felt that math was less difficult to learn, and predicted that they would get higher test scores than students with lower self efficacy (all correlations $p < .05$). The classroom mathematics teacher provided grade information and independent ratings of the students' observed mathematics motivation, which were highly correlated with students' self reports (correlations $p < .01$). Although most students were quite motivated and thought they were doing well, nearly half were performing below grade expectations. Thus, there were many students who wanted to do well and seemed to be trying, but who were not actually mastering the class material. This presents a pedagogical challenge: The ITS must be designed to raise students' objective skills while sustaining motivation (e.g., having high hopes and trying hard is not enough; acquiring specific strategies and skills is also critical).

Motivation and mood. Self efficacy was strongly correlated with the students' daily mood reports, and mood predicted students' specific estimates of their likely SAT-M scores, and the perceived difficulty of the task (i.e., more positive mood associated with lower perceived difficulty).

Gender comparisons. There were no gender differences in students' mathematics motivation or mood before the ITS activity started. However, by the end of the final session, males' mood had increased, whereas females' mood had significantly declined, even though there was no objective difference in ITS problem solving performance for males and females. Mood reports were also linked to male and female students' estimates of their test score on a real exam. Initially, students estimated that their score would be about at the national average, but males' increased their score estimates as they worked with the ITS, whereas female students' estimates declined. Thus, student gender is a potentially important factor to be considered in a pedagogical model: Male and female students were performing similarly, and both felt that the material was becoming easier to learn, yet their emotional responses diverged over time, as did their expectations for successful outcomes.

Use of multimedia help. Students' perception that math is difficult was a significant predictor of their use of help resources in the tutoring system, as was self-reported intention to learn. Not surprisingly, students' use of help resources (viewing multimedia hints) was negatively correlated with the number of incorrect answers entered (guessing or, "bottoming out"). Mood did not predict guessing behavior, but students who believed that people are born with a certain innate ability in math were more likely to enter multiple wrong answers per problem (i.e., to guess) than students with "incremental" beliefs about intelligence, $F(1,39) = 5.487$, $p < .05$. Providing praise for student performance can actually undermine math motivation, and increase beliefs that native talent is most important [3]. Thus, students may benefit most from ITS feedback focusing on their effort and use of the help resources as contributors to positive learning outcomes, rather than on feedback that emphasizes performance (number correct, scores relative to other students, etc.).

In a regression analysis with students' estimated test score as the outcome variable, mood and learning intention were both significant predictors, and mood accounted for a higher proportion of the variance. Thus, for example, students who started the final session feeling relaxed, confident and at ease expected to do better on the real exam, relative to other students who had similar intentions to work hard at learning but who felt more anxious, tense and worried. This suggests that daily mood assessments will be important to include in the enhanced pedagogical model of the ITS. For example, the student who is anxious might benefit from an initial review of problems that have already been tackled, along with feedback emphasizing incremental beliefs (e.g., "small steps add up").

A second regression analysis focused on students' estimates of their likely test performance after the ITS activity was over. Gender and mood at the start of the last session were both significant predictors, whereas factors such as the number of problems completed, and the use of help resources, did not account for significant variance. Again, it appears that students' affective state influenced their response to the ITS activity, with females showing less positive mood than males.

4. Conclusions and next steps

In this initial study, we established that students were able to report their motivational beliefs and affective states, using real-time self-reporting tools integrated into the ITS. Self reports were validated by ratings and grade information provided by their classroom mathematics teacher. The next step in the project is to implement our pedagogical model and select strategies appropriate for students who show high or low motivation, positive or negative affect, and so on. The pedagogical strategies that we are implementing are based on studies of how expert human instructors help students learn difficult material while sustaining motivation.

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