Motivational & Metacognitive Feedback: Linking the Past to the Present

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Abstract. This paper explores the incorporation of metacognitive and motivational feedback into an existing Intelligent Tutoring System (ITS). Both types of feedback are formulated by using the learners' prior experiences and motivational states to improve their ability to successfully engage in problem-solving tasks.

Keywords. Motivation, metacognition, feedback, past experiences, ITS

1 Introduction

Motivation and metacognition are strongly intertwined [1]. Learners high in efficacy are more likely to use "various cognitive and self-regulatory learning strategies" [2]. Likewise metacognitive skills are required for motivation (e.g. mastery in goal theory requires insight into one's own knowledge and experience). Reflecting and drawing upon prior experience and knowledge are important in the construction of knowledge in terms of utilizing and further developing mental representations and cognitive relationships [3]. Learning from past experience involves metacognitive processes as an act of "reflection on experience" [4]. However, [5] acknowledges that we tend not to be good at recognizing how a past problem can help us with the current one. There have been successes in developing ITSs to address metacognition [6, 7], and our research is looking at the relation of this to motivation.

2 Aims and Objectives

Our aim is to improve the learner's focus on the process and experience of problem-solving, by addressing the questions; how effective are different types of feedback (domain, motivational and metacognitive) guided by prior learning experiences and motivational states? What guidelines are required to determine which feedback type to use and when? The potential staging points considered are the start of a session, start of a task, potentially when a learner requests help, end of a task and end of a session. A session is defined as one period of use regardless of length of time.

3 Methodology

An existing ITS (SQL-Tutor) is being used as the base ITS. SQL-Tutor provides an environment for learners to practice and develop their SQL skills, and has successfully made the transition from research tool to wide-spread use. SQL-Tutor contains a rich open learner model that is based on the Constraint-Based Model approach [8].

The functionality of SQL-Tutor will be extended to include metacognitive and motivational feedback to the learner. This feedback will specifically refer the learner to past metacognitive processes and motivational states to contextualise current issues (such as being stuck). In order to record additional, relevant data, two log files have been designed; one focuses on the timeline of sessions and the other on the timeline of problems. Both log files include activity and self-report data (e.g. help levels encountered, the degree of self-efficacy reported by the learner).

A rules engine will be developed to a) decide when to prompt a learner to self-report on their motivational state (using self-efficacy), b) to determine which prior experience and/or motivational state is relevant for the feedback, and c) to formulate the feedback. While using self-report to gauge motivational state may have potential issues (e.g. interference in the learning itself or the learner pleasing the system [2, 9]), it provides a direct method to capture the learner's thoughts and steps can be taken to minimize any potential issues as discussed in [2]. The feedback will be guided by both previous learning experiences and motivational states of the learner, thereby providing an opportunity for the learner to reflect and draw upon their own learning experiences. In order to achieve this, the concept of relating similar problems by means of templates will be incorporated from a previous study using SQL-Tutor [10].

Two studies will be conducted which will target first year University undergraduate students on computer science and/or business information systems courses. The first is a pilot study which will extend the base SQL-Tutor to include a degree of metacognitive and motivational feedback. It will be used to gain student response to the additional feedback types, including its presentation/timing. The results of this pilot study will be used to direct any changes required before the main study. The main study will be run over a three month period of the participants using SQL-Tutor and will compare learner behaviours and post-activity test results of learners who used different versions of the ITS exploring different feedback regimes, as opposed to an ITS with feedback based only on the current problem.

4 Current State, Expected Contribution and Future Work

The initial design of the additional log files has been completed, along with analysis of the templates used in a previous study of SQL-Tutor. The implementation of the logs in terms of recording is currently underway. The rules engine that governs when a learner is prompted for self-report, as well as formulating the metacognitive and motivational feedback, is currently being designed. The pilot study is scheduled for later in 2011, once the rules engine has been implemented. The results will be studied

and further development work will take place before the main study is scheduled for 2012 (the Doctorate work is being undertaken on a part-time basis).

This research aims to contribute to the AIED community by broadening the interaction of an ITS by providing three types of feedback; domain, motivational and metacognitive. The interaction will be further extended by using the prior experiences and motivational states of the learner to formulate the latter two feedback types, as opposed to using just the current affective state (e.g. Prime Climb [11]) or displaying the solution to a past problem as a reminder (e.g. ELM-ART [12]).

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