Chapter 13

Affective Educational Games and the Evolving Teaching Experience

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ABSTRACT

Teaching methods must adapt to learners’ expectations. Computer game-based learning environments enable learning through experimentation and are inherently motivational. However, for identifying when learners achieve learning goals and providing suitable feedback, Intelligent Tutoring Systems must be used. Recognizing the learner’s affective state enables educational games to improve the learner’s experience or to distinguish relevant emotions. This chapter discusses the creation of an affective student model that infers the learner’s emotions from cognitive and motivational variables through observable behavior. The control-value theory of ‘achievement emotions’ provides a basis for this work. A Probabilistic Relational Models (PRMs) approach for affective student modeling, which is based on Dynamic Bayesian Networks, is discussed. The approach is tested through a prototyping study based on Wizard-of-Oz experiments and preliminary results are presented. The affective student model will be incorporated into PlayPhysics, an emotional game-based learning environment for teaching Physics. PRMs facilitate the design of student models with Bayesian Networks. The effectiveness of PlayPhysics will be evaluated by comparing the students’ learning gains and learning efficiencies.

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INTRODUCTION

Space and flight simulators signaled the beginning of a new revolution for training, teaching and learning (Bergeron, 2006). Technology has made remarkable progress in computing and electronics, which have converged in the game development area. Students have grown up playing video games, exposed to a large quantity of visual and acoustic stimulus and inhabit a world strongly influenced by Information Technology (IT). As a result, achieving knowledge, understanding and motivation during the teaching-learning experience has become more challenging (Oblinger, 2004). The ultimate goal has been to create enhanced learning environments that will be able to deal successfully with the learners’ expectations. Intelligent game-based learning environments, e.g. educational games, facilitate teaching through experience by offering immediate feedback and engaging the learner’s attention (Squire, 2003). As a result, an emotional link is established between the learner and the game. This feature results in these game environments becoming straightforward motivational tools.

Game-based learning environments must follow design approaches and principles that make them capable of offering effective learning (Schaller, 2005). Learning goals must lead and encourage the learner’s exploration. An assessment criterion must be incorporated to evaluate the learner’s skills and performance, and to distinguish the knowledge topics that are understood and mastered by the student from those which are lacking. It is important to note that learning to play a game effectively does not ensure mastering the domain knowledge, since games are composed of a set of rules, which define the gameplay, that are not necessarily related to the learning content. Suitable feedback must be provided when a learning need is identified. Therefore, Intelligent Tutoring Systems (ITSs) are incorporated into the architecture of intelligent game learning environments (Conati & Maclaren, 2009), since ITSs encourage independent learning and provide adaptable responses according to each student’s pace, form of learning and history of interaction.

On the other hand, emotion has been shown to influence learning and performance. Emotion, cognition and motivation are deeply interrelated (Pekrun, Frenzel, Goetz, & Perry, 2007). Hence, research is focused on enhancing the learner’s understanding and engagement by intelligently and effectively managing the affective aspects of educational games. The aim is to communicate effectively an emotional state, which will change the learner’s disposition and emotional states to those that facilitate learning and understanding (Conati & Maclaren, 2009). However, to know if the desired effects will be achieved, it is necessary to enable these systems to identify the learner’s affective or motivational states. Finding a solution to this challenge has been the focus of several research areas, e.g. Affective Computing, ITSs and Game-based Learning Environments. Affective Computing focuses on enabling computers to express and recognize emotion (Picard et al., 2004). ITSs are currently being enhanced to incorporate the emotional dimension into their framework. This chapter focuses on the specific challenges of how to design effective game-based learning environments, how to identify the learner’s emotional state and how to adapt and respond to the learner’s actions and disposition. To attain this objective the state of the art of Intelligent Game Learning Environments, ITSs and Multimodal Output Adaptation related to Affective Computing is first discussed. An affective student model, which infers the learner’s emotional states from cognitive and motivational variables, is proposed. To infer emotion an approach focusing on analyzing the learner’s observable behavior, qualitatively and quantitatively, is applied. A methodology of designing an affective student model using Probabilistic Relational Models (PRMs), e.g. Bayesian Networks (BNs), is described. The affective student model is based on the Control-Value theory of ‘achievement emotions’. **PlayPhysics,**
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