An Emotional Games Learning Environment for Teaching Physics

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I. Aims and Objectives

- Creation of an affective student model to infer and reason about learners' emotions.
- Select pedagogical, motivational and affective actions that maximise students' learning, understanding and motivation.
- Design, implement and test PlayPhysics, an emotional games learning environment for teaching Physics at undergraduate level.

II. Affective Educational Games and Intelligent Tutoring

- Game-based learning environments actively involve students and enable them to learn through experiencing the effects of their actions (Squire, 2003).
- Educational games are multi-sensorial environments where mastery and skill are rewarded.
- Affective gaming focuses on influencing and identifying the player's emotional state.
- An Intelligent Tutoring System (ITS) is incorporated into a game-based learning environment to achieve effective assessment criteria.

III. Affective Student Modelling

- Presently, there is no system that can recognise accurately all the learner's emotions.
- We focus on building an affective student model from cognitive and motivational variables using observable behaviour.
- Dynamic Bayesian Networks (DBNs) were derived (e.g. Figure 1) using a Probabilistic Relational Models (PRMs) approach based on the 'Control-Value Theory of Achievement Emotions' (Pekrun et al., 2007).

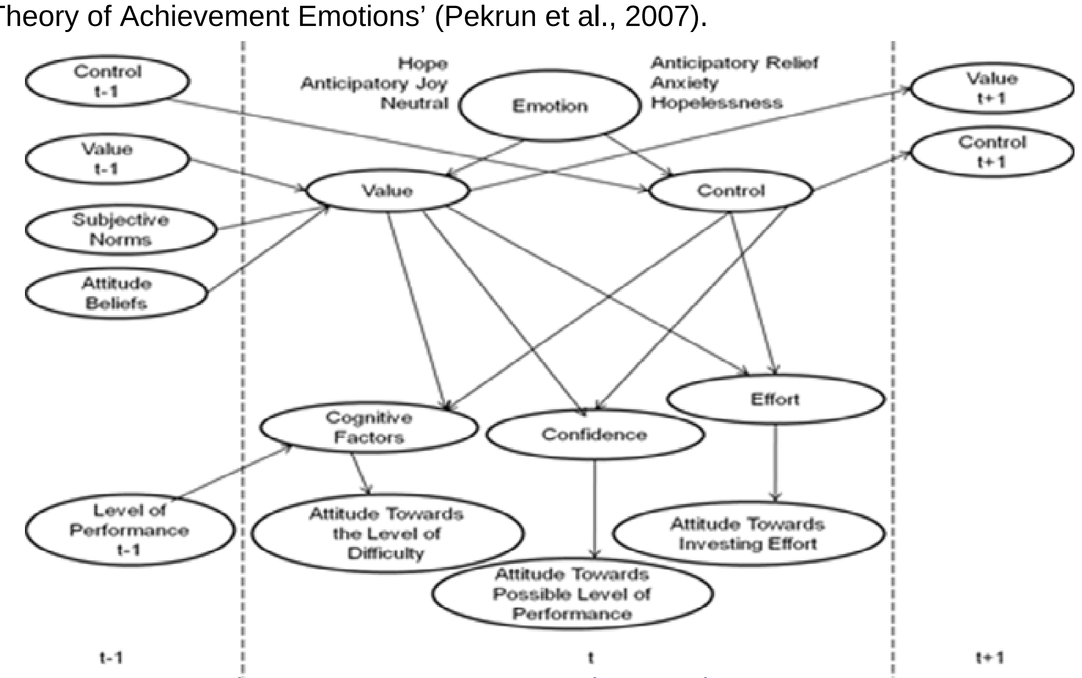

Figure 1. Outcome-prospective emotions DBN

IV. PlayPhysics Design and Implementation

- *PlayPhysics* includes a space adventure scenario (Figure 2) where learners must solve diverse challenges by applying their knowledge of Physics.

Figure 2. PlayPhysics GUI (left) and player-characters (right)

V. Tutor Model and Multimodal Output Modulation

- Dynamic Decision Networks (DDNs) are incorporated into Olympia (Figure 3) to select the pedagogical or motivational action that maximises understanding of the structure underlying Physics, e.g. hints, questions, micro-explanations.
- Visuals and sounds create a sense of immersion, indicate changes in narrative, set a mood and decrease the learning curve (Collins, 2008; Lester & Stone, 1997).
- Colours will reflect the learner's emotion or an emotion that aims to counteract the learner's negative state (Kaya, 2004).

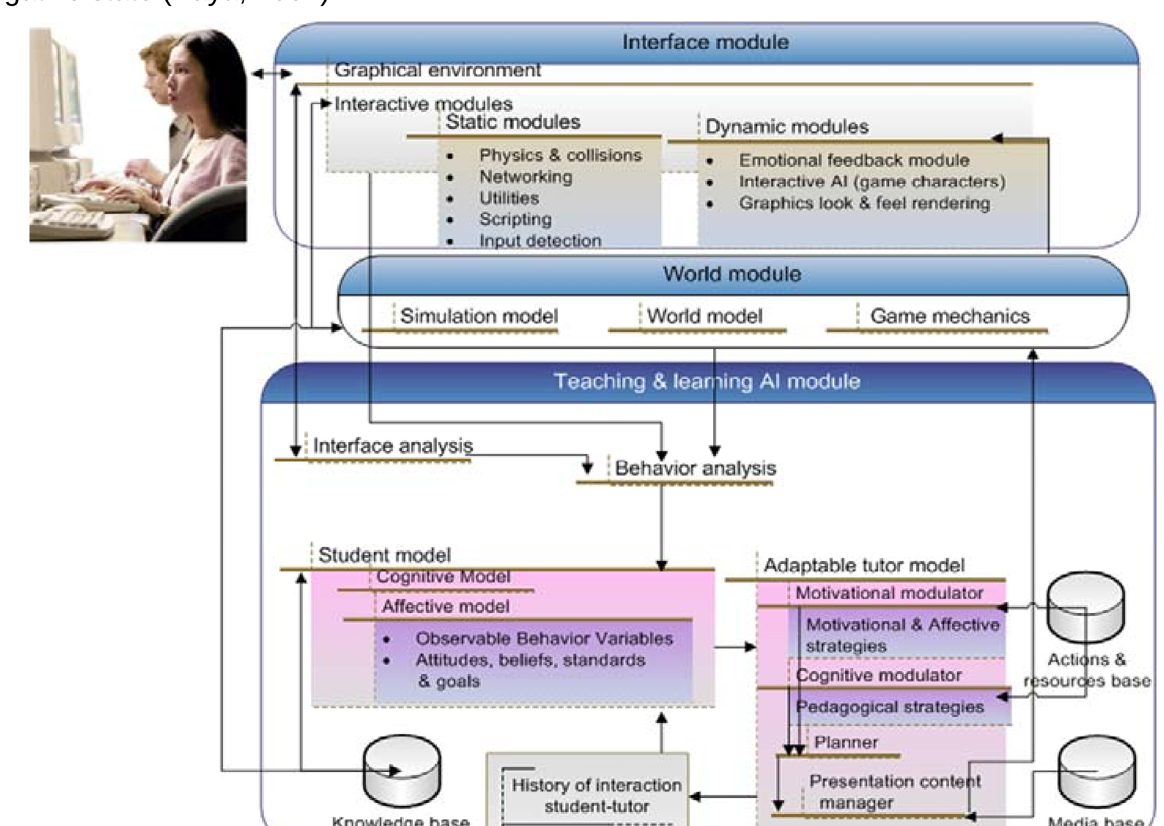

Figure 3. Olympia achitecture

VI. Preliminary Evaluation of the Affective Student Model

- A pre-test and a questionnaire, comprising PlayPhysics' topics and game dialogue, were applied to 28 students at Tecnológico de Monterrey, Mexico City.
- The evidence obtained through the two questionnaires was propagated in the outcome-prospective emotions DBN.
- Results obtained through comparing the inferred emotion by PlayPhysics' affective student model with the students' reported emotion, showed an accuracy of 60.71% (Figure 4).

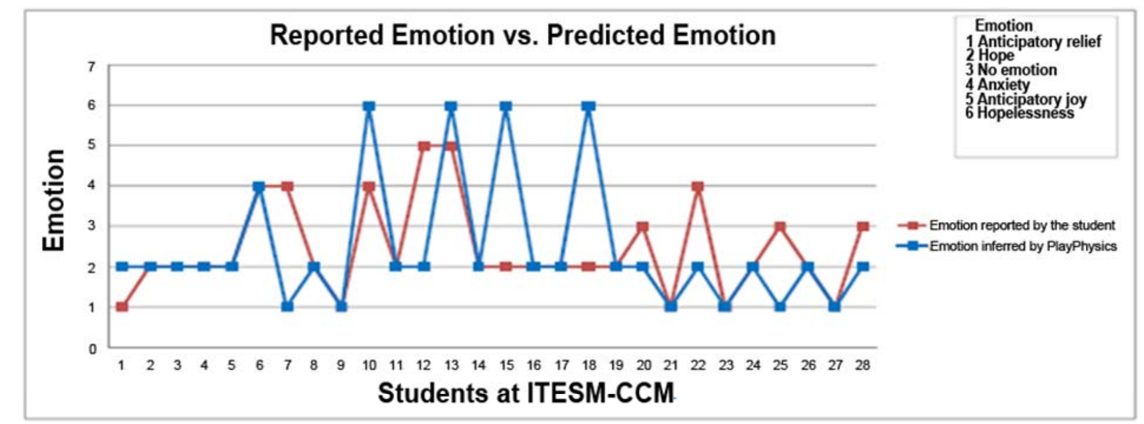

Figure 4. Students' reported emotion vs. PlayPhysics' predicted emotion

VII. Conclusion and Future Work

- PlayPhysics reasons about learners' emotions using the Control-Value Theory of Achievement Emotions.
- Results show promise when evaluating the prospective-outcome emotions DBN.
- Further tests will be conducted with a larger population of students and with the other DBNs on completion of implementation of the first challenge.

VII. Publications

- Muñoz, K., P. Mc Kevitt, T. Lunney, J. Noguez & L. Neri (2011). Affective Educational Games and the Evolving Teaching Experience. In "Business, Technological and Social Dimensions of Computer Games: Multidisciplinary Developments", M. Cruz-Cunha, V. H. Carvalho & P. Tavares, (Eds.). Pennsylvania, Philadelphia, EUA: IGI Global.
- Muñoz, K., J. Noguez, P. Mc Kevitt, T. Lunney & L. Neri (2010a). Work in progress – Towards an Emotional Learning Model for Intelligent Gaming. In Proc. of the 40th IEEE International Conference on Frontiers in Education (FIE-10), Crystal Gateway Marriott, Virginia, Washington D.C., USA, October 27 - 30, T3G-1 – T3G-2.
- Muñoz, K., P. Mc Kevitt, T. Lunney, J. Noguez & L. Neri (2010b). PlayPhysics: An Emotional Games Learning Environment for Teaching Physics. In Proc. of the 4th International Conference on Knowledge, Science, Engineering and Management (KSEM-10), Y. Bi & M.A. Williams, (Eds.), Europa Hotel, Belfast, Northern Ireland, UK, September 1-3. Heidelberg, Germany: Springer Verlag.