PlayPhysics

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 involve students actively 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).

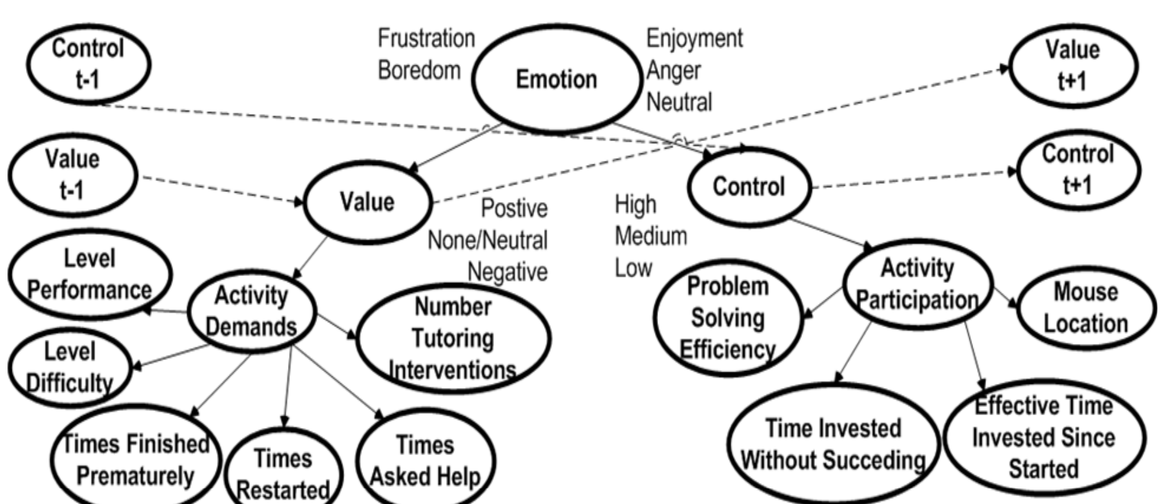

Figure 1. Activity emotions DBN

IV. PlayPhysics Design and Implementation

- Requirements analysis was conducted online with lecturers and students of Physics at undergraduate level (Figure 2).

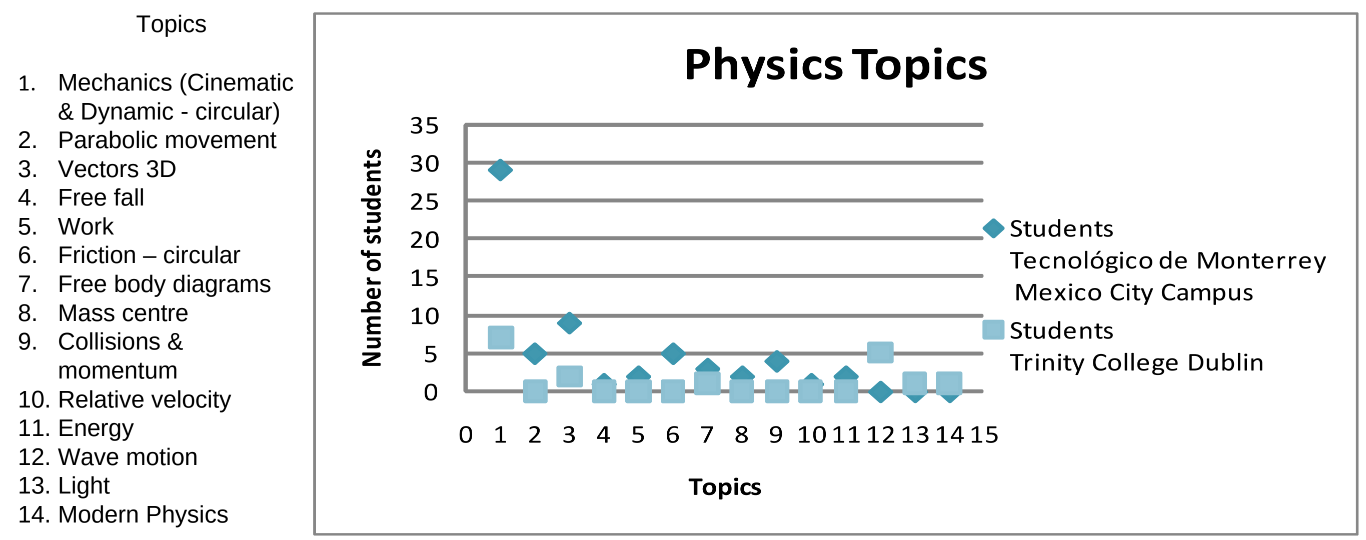

Figure 2. Most challenging topics in an introductory Physics course

- PlayPhysics includes a space adventure scenario (Figure 3) where learners must solve diverse challenges by applying their knowledge of Physics.

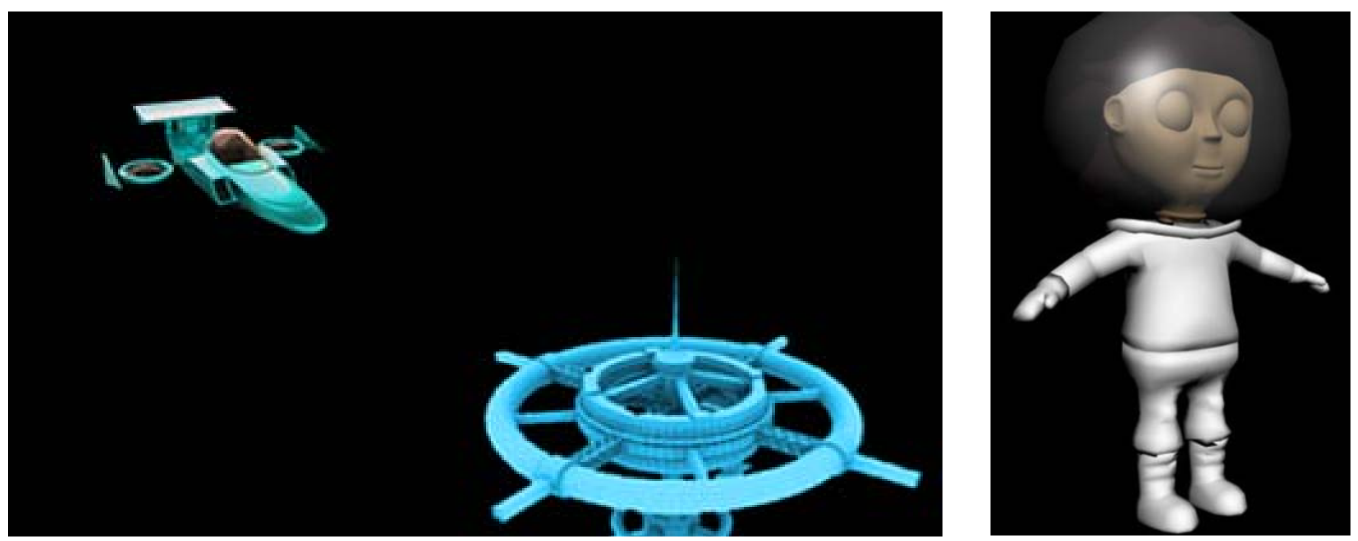

Figure 3. PlayPhysics GUI (left) and key game character (right)

V. Tutor Model and Multimodal Output Modulation

- Dynamic Decision Networks (DDNs) are incorporated into Olympia (Figure 4) 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).

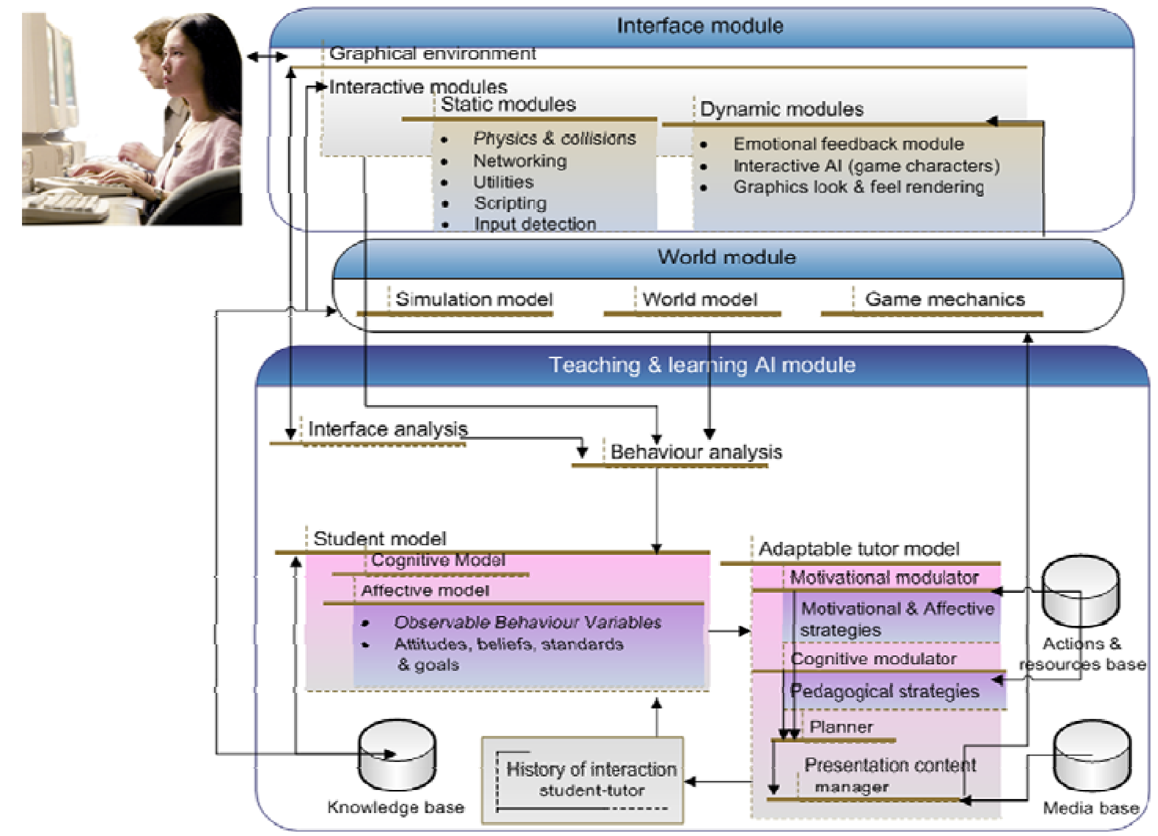

Figure 4. Olympia achitecture

VI. Conclusion and Future Work

- PlayPhysics reasons about the learners' emotions using the Control-Value Theory of Achievement Emotions and provides motivational or pedagogical actions in the form of visuals, sounds and colours.
- The affective student model will be evaluated through a prototyping exercise based on Wizard-of-Oz experiments and the effectiveness of PlayPhysics will be tested through pre- and post- tests.

VII. Publications

- Muñoz, K., P. Mc Kevitt, J. Noguez & T. Lunney (2009a). Combining educational games and virtual learning environments for teaching Physics with the Olympia architecture. In *Proc. of the 15th International Symposium on Electronic Art (ISEA-09)*, Waterfront Hall, Belfast, Northern Ireland, August 23 -September 1.
- Muñoz, K., J. Noguez, P. Mc Kevitt, L. Neri, V. Robledo-Rella & T. Lunney (2009b). Adding features of educational games for teaching Physics. In Proc. of the *39th IEEE International Conference on Frontiers in Education (FIE-09)*, Hotel Hilton Palacio del Rio, San Antonio, Texas, USA, October 18 - 21, M2E-1 - M2E-6.
- Noguez, J., L. Neri, V. Robledo-Rella & K. Muñoz (2009). Inferring knowledge from active learning simulators for Physics. In Proc. of the *8th Mexican International Conference on Artificial Intelligence (MICAI-09): Advances in Artificial Intelligence*, Hernández, A., Monroy, R. & Reyes, C. A., (Eds.), 533-544, Guanajuato, México, November 9 - 13. Berlin, Germany: Springer.