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).

IV. PlayPhysics Design and Implementation

- Requirements analysis was conducted online with lecturers and students of Physics at undergraduate level (Figure 2).
- Topics included in PlayPhysics are:
  1. Mechanics (Cinematic & Dynamic - circular)
  2. Parabolic movement
  3. Vectors 3D
  4. Free fall
  5. Work
  6. Friction – circular
  7. Free body diagrams
  8. Mass centre
  9. Collisions & momentum
  10. Relative velocity
  11. Energy
  12. Wave motion
  13. Light
  14. Modern Physics

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

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).

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