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Work-in-Progress – Towards an Emotional Learning Model for Intelligent Gaming

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Outline of presentation

- Related work
- Emotional Learning Model
- PlayPhysics Design & Implementation
- Evaluation & Results
- Conclusion & Future Work

Background & related work

- Game-oriented learning
  - Interactive and emotional link

  CHALLENGE: Achieving Knowledge & Understanding

- Following Design Principles (Malone & Lepper, 1987) & Providing Adaptable Guidance
  - Intelligent Tutoring Systems (ITSs)

    (Conati & Maclaren, 2009; Blanchard & Frasson, 2006)

- Student Modelling (Wolf, 2009; Sucar & Noguez, 2008)

- Affective Gaming (Sykes, 2006)

- Approaches for recognising emotion
  - Recognising Physical effects (Sarrafzadeh et al., 2008; D' Mello et al., 2008)
  - Reasoning about emotion from its origin (Jaques & Vicari, 2007)
    - OCC Model (Ortony et al., 1990)
  - Hybrid approach (Conati & Maclaren, 2009)
- Recognising students' motivation (Rebolledo-Mendez, et al., 2006) & self-efficacy (McQuiggan et al., 2008)
- Control-Value theory of Achievement Emotions (Pekrun et al., 2007)

Research aim

- Creating an emotional student model to reason about the learners' emotions from observable behaviour during game-play using cognitive & motivational variables

Emotional Student Model

- Student modelling involves uncertainty (Sucar & Noguez, 2008)
  - Which emotions must be recognised?
  - Which factors & features must be taken into account

Research Approach

Control-value theory

Probabilistic Relational Models approach

Dynamic Bayesian Networks

The Control-Value Theory

- Achievement Emotions
  - Defined according to the focus & time frame
    - Prospective-outcome, activity & retrospective-outcome
  - Domain dependent

- Appraisals of control & value are the most relevant when determining & emotion
  - Motivational, cognitive & physiological variables

Table 1. Summary of the Control-Value Theory by Pekrun et al. [6]

Time frame/ focus on	Value appraisal	Control appraisal	Emotion
Prospective/ Outcome	Positive (Success)	High	Anticipatory Joy
		Medium	Hope
		Low	Hopelessness
	Negative (Failure)	Low	Hopelessness
		Medium	Anxiety
		High	Anticipatory relief

Table 1. Fragment of the Control-Value Theory by Pekrun et al. (2007)

Figure 1. PRM based on the control-value theory.

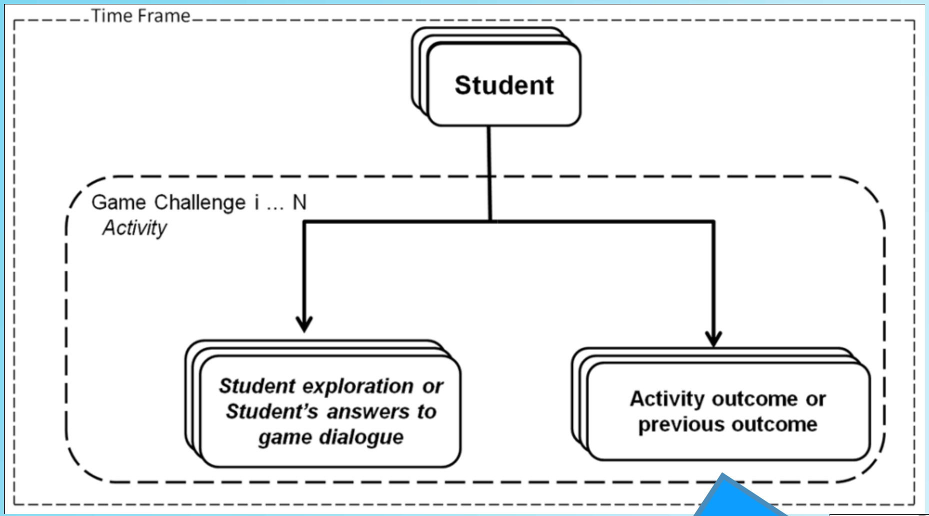
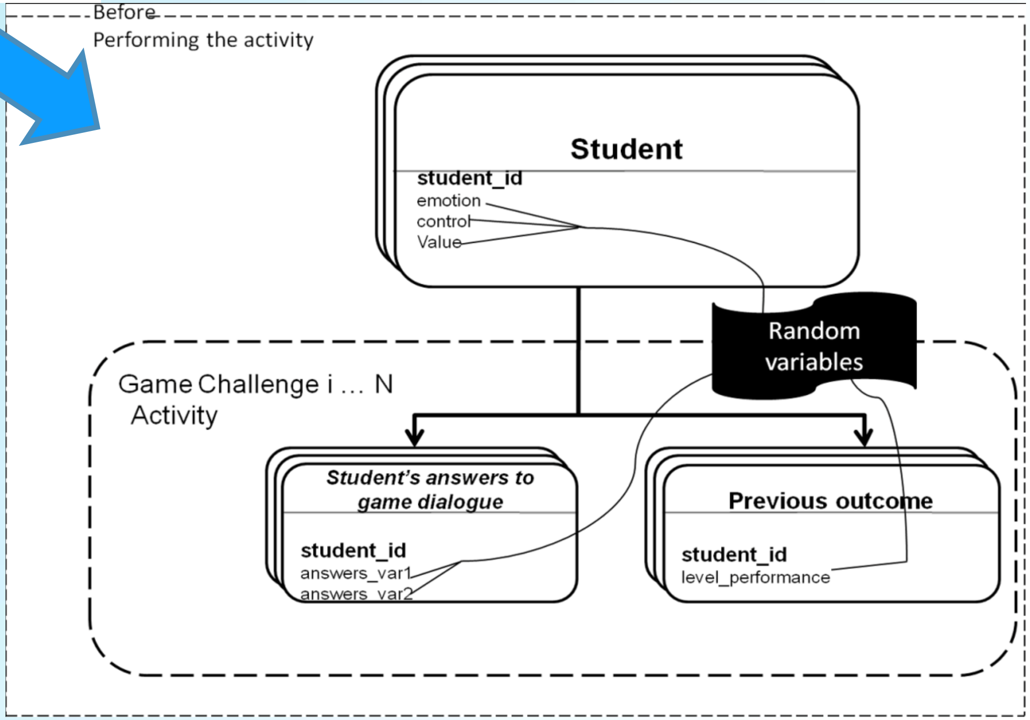


Figure 2. PRM instance according to the time frame *'Before'*.



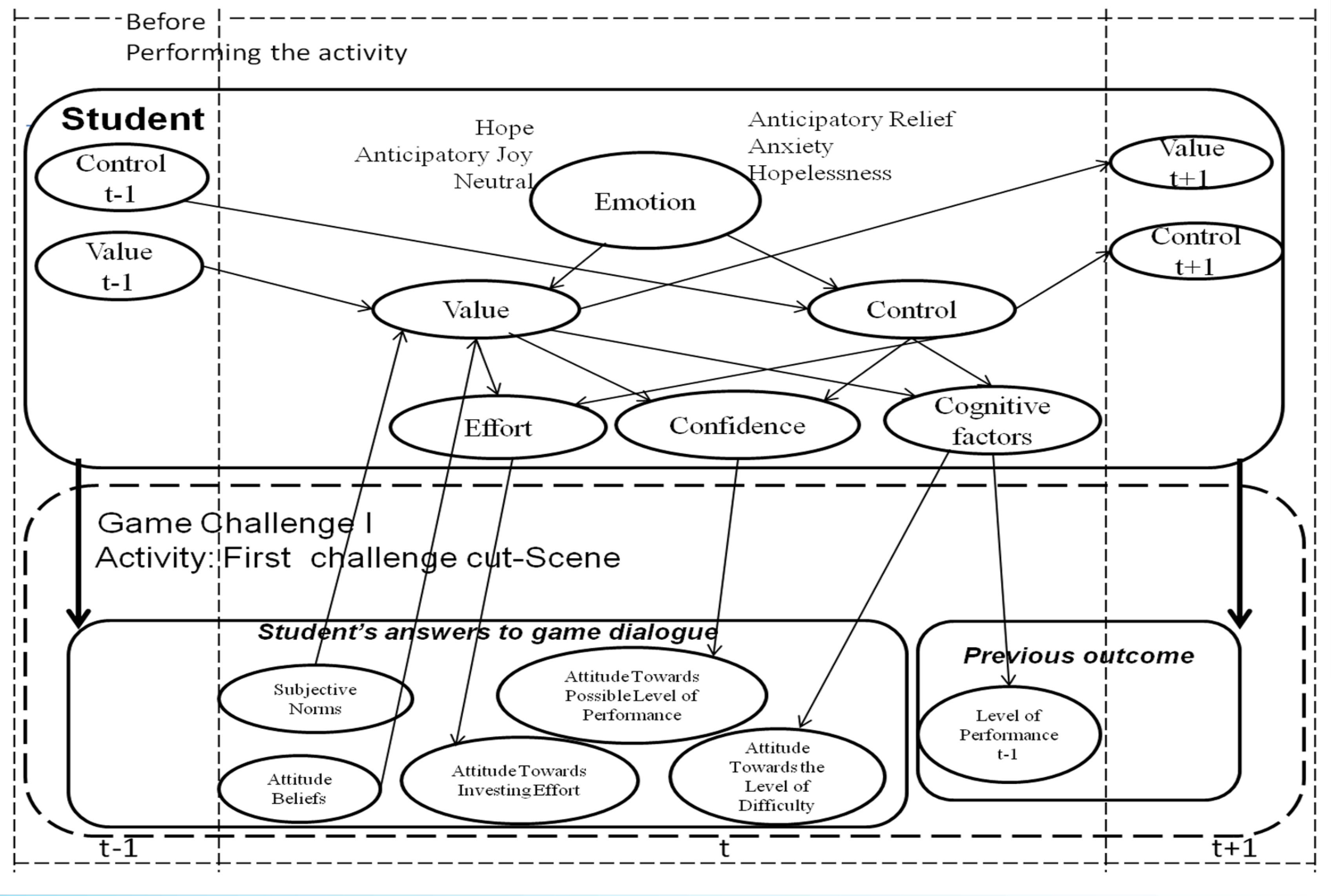


Figure 3. Prospective-outcome emotions DBN

Figure 2. Fragment of PlayPhysics game dialogue based on the AEQ

PlayPhysics design

- Students find it difficult to understand & apply the underlying principles of Physics
- PlayPhysics uses Olympia architecture (Muñoz et al., 2009)
- Olympia will be modified to recognise the students' emotions & provide pedagogical actions, which involve emotional responses delivered through game elements
- The most difficult topics in an introductory Physics course were identified through an online survey
  - Trinity College Dublin & Tecnológico de Monterrey .
- The story-line of PlayPhysics is a space adventure

First Challenge

- Involves piloting a spaceship to Athena by applying knowledge about vectors, principles of linear and circular kinematics and Newton's laws for particles and rigid bodies.
- Unity Game Engine, 3D Studio Max, JSPs, Servlets, Elvira & Hugin Lite

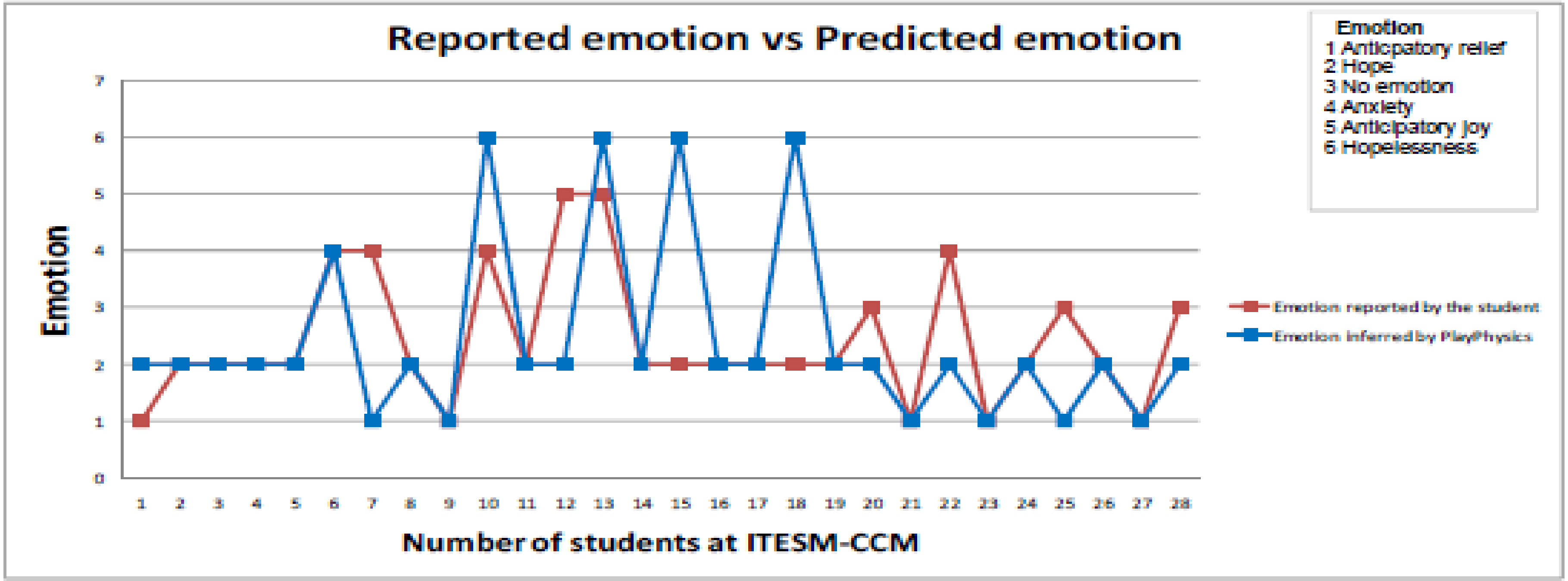
Figure 4. PlayPhysics first challenge GUI

Figure 5. PlayPhysics Player-characters

Evaluation & Results

Pre-test & Knowing result → Answering Game-dialogue → Comparison between reported emotion & inferred emotion

- Evaluation of the Prospective-outcome emotions DBN



- Some students did not know how to classify the emotion that they were feeling (confidence & effort)
- The confidence reported by the student correlated poorly with question 5 of the game-dialogue, therefore question 2 will be used , which improves the correlation.
- Some probabilities in the Conditional Probability Tables (CPTs) need improvement. Therefore the data obtained from this test will be used to adjust the probabilities.
- Also the data obtained is being analysed with Discriminant Analysis to remove variables and dependency links that are not necessary.
- Further tests with a larger population of students are necessary

Conclusion & future work

- Design of an Emotional student model that reasons about emotion during game-play using cognitive and motivational variables
- A PRM approach & as a basis the Control-Value theory of achievement emotions
- The results show promise when evaluating the prospective-outcome emotions DBN. However it will be necessary to conduct further tests with a larger population of students and with the other DBNs once the implementation of the first challenge is completely finished

Questions

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