Adding features of educational games for teaching Physics

Karla Cristina Muñoz Esquivel¹, Julieta Noguez², Paul Mc Kevitt¹, Luis Neri², Victor Robledo-Rella² & Tom Lunney²

University of Ulster, Magee¹
Tecnológico de Monterrey, Campus Ciudad de México²

E-mail: munoz_esquivel-k@email.ulster.ac.uk, jnoguez@itesm.mx, p.mckevitt@ulster.ac.uk, {neri, vrobledo}@itesm.mx, tf.lunney@ulster.ac.uk

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Outline

• Background & related work
• Research
  • Aims & objectives
  • Olympia architecture
  • Case study & methodology
  • GUI design
  • Design & student model
  • Evaluation
• Conclusion & future work
Background & related work

- Understand the coherent structure underpinning Physics
- Virtual laboratories (VLs) provide significant learning experiences (Reilly, 2008)
  - Link objects & events (Virtual Learning Environments - VLEs) with real world concepts & phenomena
- Open Learning Environments
- Positive effects are attained by enhancing Human Computer Interaction (HCI) (Conati, 2008; D’Mello, 2008)
- Educational games more easily attain students’ attention (Conati, 2002)
Aims & objectives

• Improve student understanding & motivation through adding features of educational games & AI techniques to VLs

• Test hypothesis in specific case study -> teaching Physics (e.g. linear momentum) at undergraduate level

• Evaluating the performance of Olympia
  • Improved Probabilistic Relational Model (PRM)
  • Tutorial videos
  • Feedback refined
Olympia architecture

- Olympia combines features of VLEs & educational games (Adams & Rollings, 2007; Sherrod, 2007; Bergeron, 2005) with Intelligent Tutoring Systems (ITSs)

- Based on research work of Noguez et al. (2007)

- Student Model is a PRM
  - infers student’s cognitive state through interacting with the system
Case study & methodology

Design & implement traditional VL & Game VL (GVL) using Olympia for teaching linear momentum

Analysis of results based on research work of Hake (1998)

1. Pre-phase – pre-test
2. Interaction
   (Control, VL & GVL)
3. Post-phase – post-test
Design & student model

Problem selection

GUI design
Exploration parameters & assessment
Knowledge inference

Feedback

Bayesian net derived from relational student model
GUI design
## Evaluation

<table>
<thead>
<tr>
<th>GROUP</th>
<th>N</th>
<th>Pre-Test</th>
<th>Post-Test</th>
<th>$G_{rel}$</th>
<th>G</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL</td>
<td>11</td>
<td>59 ±23</td>
<td>73 ±26</td>
<td>0.27±0.33</td>
<td>14 ±13</td>
<td>0.28±0.15</td>
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<tr>
<td>GVL</td>
<td>12</td>
<td>65 ±27</td>
<td>79 ±18</td>
<td>0.57±0.20</td>
<td>15 ±14</td>
<td>0.49±0.38</td>
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<tr>
<td>CONTROL</td>
<td>34</td>
<td>71 ±23</td>
<td>74 ±16</td>
<td>0.19±0.15</td>
<td>3 ±10</td>
<td>-</td>
</tr>
</tbody>
</table>

$G_{rel} = \frac{(PostTest - PreTest)}{(100 - PreTest)}$

$G = (PostTest - PreTest)$
Conclusion & future work

- Olympia -> teaching introductory Physics at undergraduate level
- Students using GVL have better performance than students using traditional VL
- Students using GVL are more engaged -> higher efficiency
- Additional experimentation
- Validation of best pedagogical action in the tutor model
- Provide suitable affective & pedagogical learning responses
- Implement educational games for teaching Physics
Questions