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Combining educational games and virtual learning environments for teaching Physics with the Olympia architecture

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Outline of presentation

- Background & related work
- Olympia
  - Aims & objectives
  - Olympia architecture
  - Case study & methodology
  - GUI design & student model
  - Results & evaluation
- Conclusion & future work

Background & related work

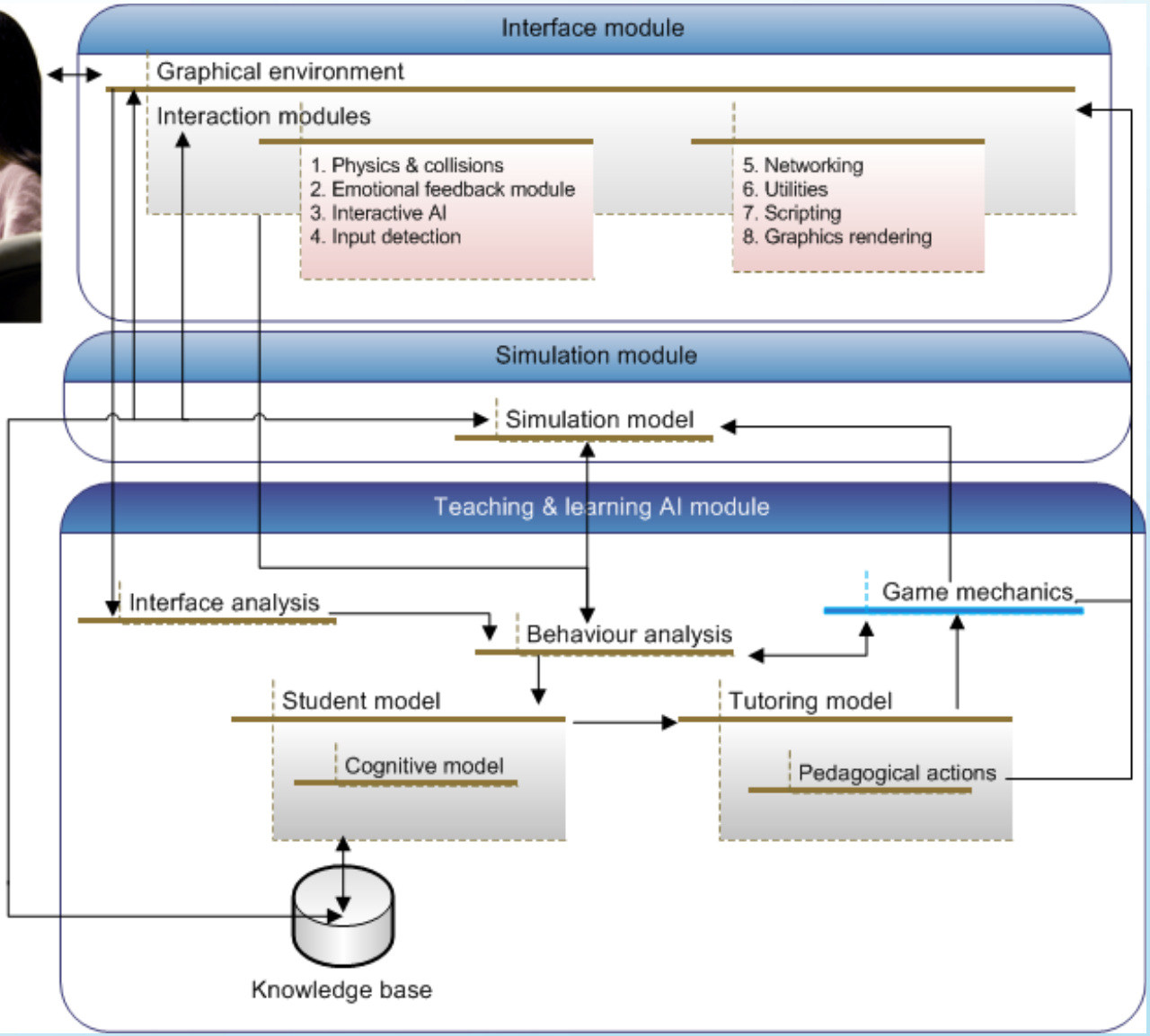
- Ultimate goal: Make teaching & learning more effective
- Virtual learning environments (VLEs) & educational games
  - Subliminal messages (Williams 2008)
  - Enhance Intelligent Tutoring Systems (ITSs): Recognising & expressing emotions (Conati 2002, D'Mello 2008)
- Emotion & cognition -> deeply intertwined & equally important (Norman et al. 2003)
- VLEs vs. Educational & commercial games: Features and modules of commercial & educational games -> High level of interactivity -> Emotional link (Noguez & Sucar 2005, Neji & Ben Ammar 2007, Duarte et al. 2008, Adams & Rollings 2007, Sherrod 2007, Bergeron 2005)

Aims & objectives

- Enhance VLE's Human Computer Interaction (HCI) level using features of commercial & educational games
- Enhance student motivation & understanding
- Test hypothesis in specific case study: Teaching Physics at undergraduate level

Olympia architecture

- Enables combination of VLEs, educational games & new generation of VLEs with ITSs
- Originated and based on the generic architecture introduced by Noguez & Sucar (2005)
- Semi-open environment (Noguez & Sucar, 2006)


Interface module
Graphical environment
Interaction modules
1. Physics & collisions
2. Emotional feedback module
3. Interactive AI
4. Input detection
5. Networking
6. Utilities
7. Scripting
8. Graphics rendering
Simulation module
Simulation model
Teaching & learning AI module
Interface analysis
Behaviour analysis
Game mechanics
Student model
Cognitive model
Tutoring model
Pedagogical actions
Knowledge base

Case study & methodology

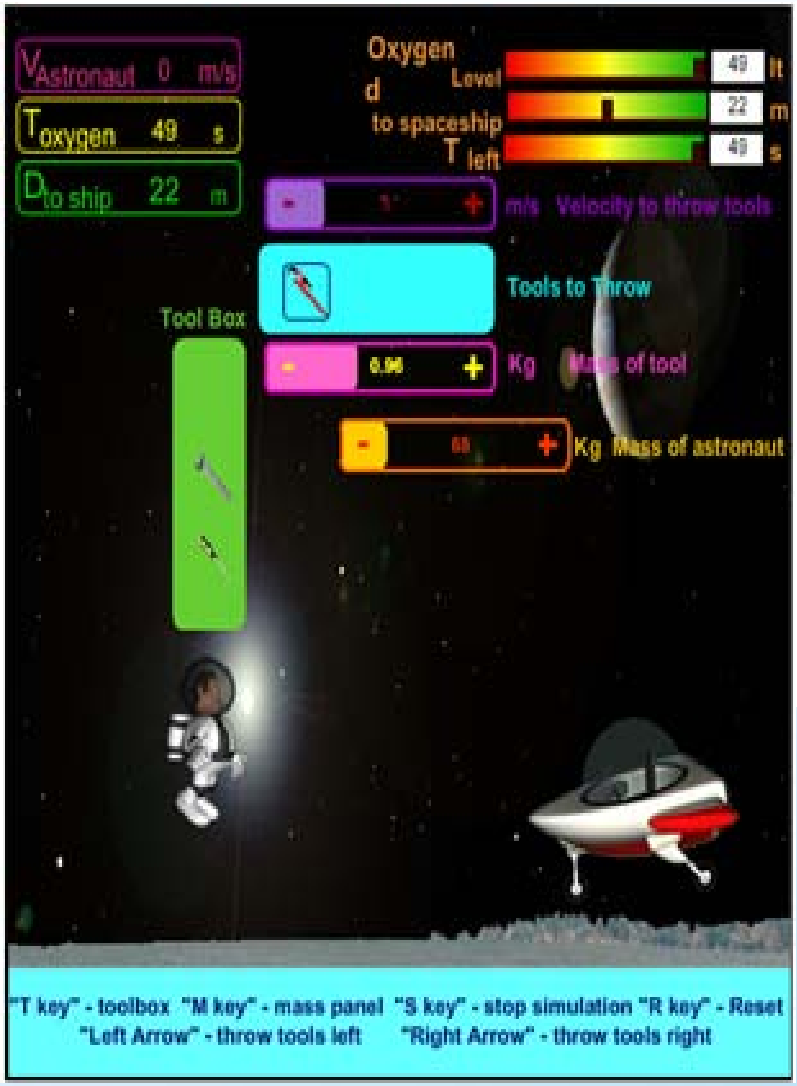
Implemented enhanced & traditional VLEs using Olympia architecture for teaching momentum

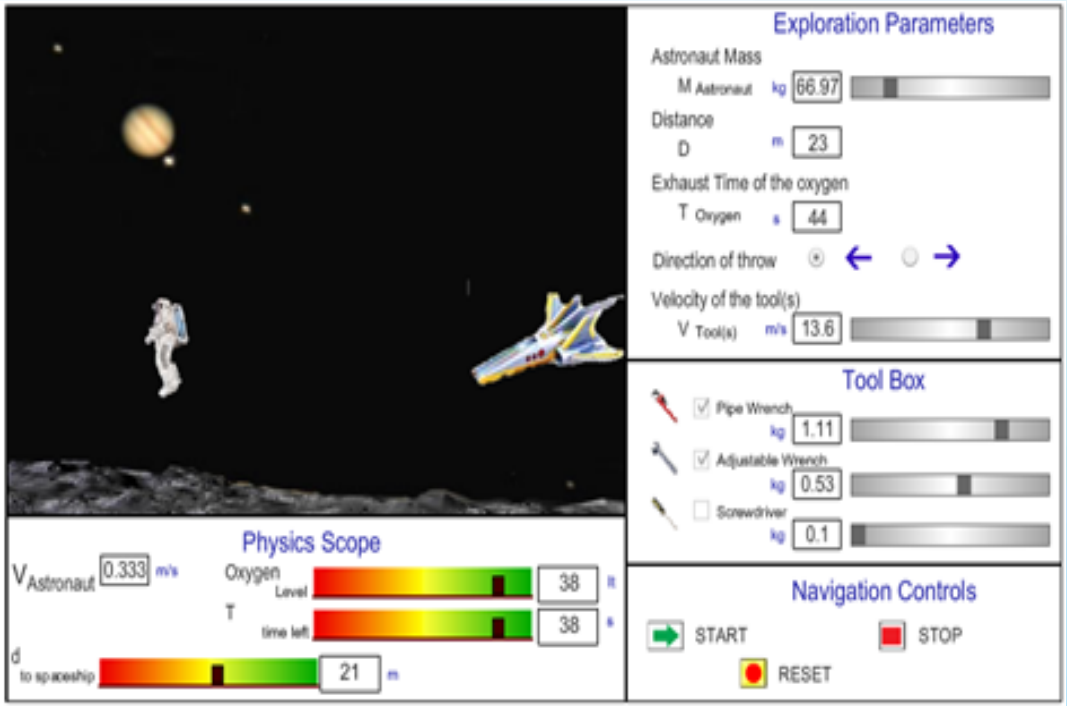
Divided 20 undergraduate students (ITESM-CCM) into experimental & control groups

Students interacted with the corresponding VLE

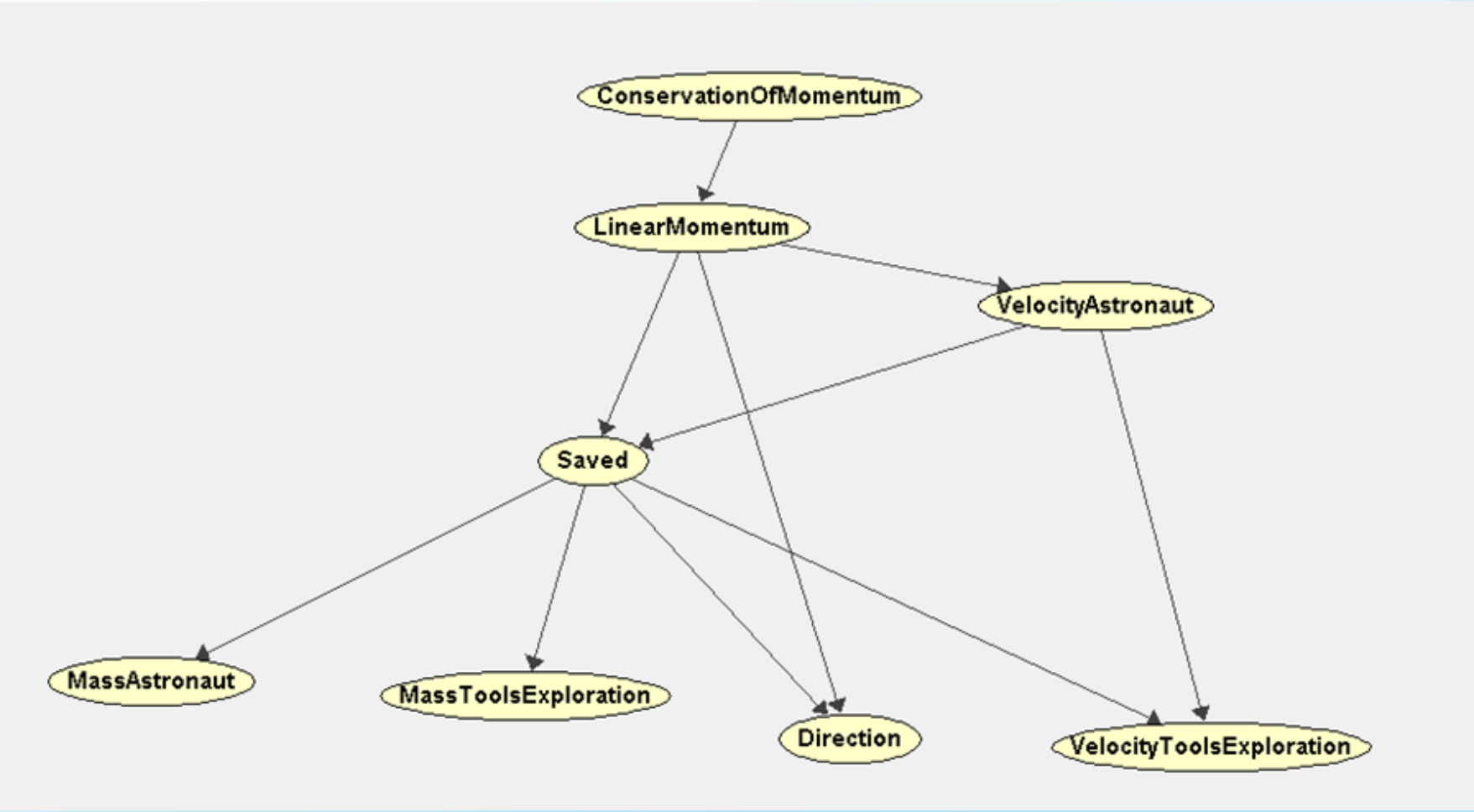
Results were evaluated using Weighted hypothesis testing (Wasserman 2004)

GUI design


V Astronaut 0 m/s
T oxygen 49 s
D to ship 22 m
Oxygen Level 49 lt
d to spaceship 22 m
T left 49 s
m/s Velocity to throw tools
Tools to Throw
Tool Box
Kg Mass of tool
Kg Mass of astronaut
"T key" - toolbox "M key" - mass panel "S key" - stop simulation "R key" - Reset
"Left Arrow" - throw tools left "Right Arrow" - throw tools right


Exploration Parameters
Astronaut Mass
M Astronaut kg 66.97
Distance
D m 23
Exhaust Time of the oxygen
T Oxygen s 44
Direction of throw
Velocity of the tool(s)
V Tool(s) m/s 13.6
Physics Scope
V Astronaut 0.333 m/s
Oxygen Level 38 lt
T time left 38 s
d to spaceship 21 m
Tool Box
Pipe Wrench kg 1.11
Adjustable Wrench kg 0.53
Screwdriver kg 0.1
Navigation Controls
START
STOP
RESET

Student model based on PRMs



Results & evaluation

Statistical function	Average knowledge detected (%)					
	Velocity and rectilinear uniform movement		Linear momentum		Conservation of momentum	
	Enhanced VLE	Traditional VLE	Enhanced VLE	Traditional VLE	Enhanced VLE	Traditional VLE
Average	65.88	61.83	61.09	59.69	58.81	57.67
Standard deviation	19.79	16.62	24.38	22.33	19.48	17.84
Z_0		1.09		0.28		0.29

Statistical function	InteractionResults (number of cases)			
	Successful cases		Total cases	
	Enhanced VLE	Traditional VLE	Enhanced VLE	Traditional VLE
Average	2.20	2.70	7.50	6.60
Standard deviation	2.04	2.15	4.06	2.69
Z_0		-1.04		1.50

Conclusion & future work

- Olympia incorporates features of VLEs, educational games & ITSs
- Olympia evaluated in specific case study of teaching Physics at undergraduate level
- Students feel more motivated interacting with enhanced VLE
- Experiment on a larger population
- Enhance student learning model
- Implement additional educational games

Questions