Immersive Technologies in Education

Talking Teaching Seminar

Omar K. Matar
Poiseuille Flow
Flow Past a Sphere
Rising Bubble
Chem. Eng. Fluid Mechanics Teaching

Mixing
CRI Program for Medical Students

- Collaboration: Digital Learning Hub
- Objective: Assess the impact of VR in learning
- Thee Medical Students conducted studies on 30+ subjects.
- Poster Title: Does VR increase learning gain when compared to a similar traditional learning experience?

Key Conclusions
1. VR cohort had statistically significantly higher final test results
2. VR cohort showed biggest learning gain from pre-questionnaire to test results
3. VR cohort displayed statistically significantly higher levels of enjoyment and concentration
CRI Program for Medical Students

Background
- Computer assisted learning and multimedia programmes form a key part of teaching in higher education institutions. With the shift from the information to the experience age, 92% of teenagers are online daily, experiencing new viewpoints.
- Video-based learning is defined as traditional as studies prove teaching material based on video equally effective as lectures.
- Virtual reality (VR) is an immersive tool presenting 3D environments and allowing interaction, addressing educational challenges of lack of interaction and feedback.
- This study is conducted as an objective assessment of the impact of virtual reality on learning gain, defined as the difference in skill, content knowledge and competency at two time points. Reported experience is also measured (secondary outcome), as students should be considered active contributors and not passive recipients in learning.
- With increasing costs of education to individuals and states, coupled with relatively poor rates of higher education completion, developing learning gain initiatives is needed to demonstrate value added.
- Learning gain measurement is complex; philosophical questions of what to measure, and scientific on how to measure. A balance between practically deliverable and methodologically robust is needed.

Methodology

Recruitment
- Recruited subject: N=36
- Exclusion Criteria:
  a) Extensive fluid mechanics experience
  b) Extensive VR use

Pre-experience
- 1. Pre-questionnaire to assess initial ability
- 2. Briefing for use of VR headset & controller
- 3. Test questions given and read

Experience
- VR group (N=18)
  - 10 minutes maximum time in VR
  - Exiting and re-entering VR to complete quiz permissible
- Non-VR group (N=18)
  - 7 minutes video showing ‘in VR’ experience
  - Video not re wound or paused
  - Quiz may be completed at any point during and after the video

Post-experience
- Post-questionnaire given assessing enjoyment, concentration, nausea, immersion, ease of use, duration etc.

Data analysis
- Mann Whitney U
- Post-questionnaire Quiz scores
- Normality test: Shapiro-Wilk
- Wilcoxon signed rank
- Pre-questionnaire vs Test score

Results

Figure 1: A comparison of total quiz score between groups showed VR group average higher. Non-VR group quiz scores more dispersed. Mann-Whitney U test calculated p=0.03846, showing statistical significance (p<0.05).
Molecular Dynamics

• Collaboration: Prof. Erich Muller, ChemEng
• Objective: Simulate the dynamics of molecules in VR (Solid, Liquid, Vapor Phase transition)
• Based on: Lennard Jones Potential Model
VR at Earth Sciences

- Collaboration: Mark Sutton, Royal School of Mines
- Objective: Assess the impact of VR in learning of Palaeobiology and Earth Science.
- Cases: VR Miller Indices, VR Field Work, VR Showcase
Cognitive Education and Training Framework using Virtual Reality

- Collaboration: Shell (under discussion)
- Objective: If VR can be effective for safety training along with or in lieu of conventional methods.
- Hypothesis: VR based training would be feasible and effective, in terms of human learning and recall in identifying and assessing safety risks, that would equivalent training using conventional methods.
- Proposal: VR training platform that can measure and non-invasively track the cognitive engagement and load using Brain Computing Interface (BCI), can adapt and evaluate the training process.
Social VR Learning and Interaction

- Collaboration: UROP
- Objective: Multiple users (as VR avatars) can view and interact with a fluid simulation dataset in a collaborative VR environment.
  - Audio/Video communication for distance education.
Hololens AR / Mobile VR Simulations

• Collaboration: Digital Learning Hub, Dyson School of Design
• Objective: Multi-user Holographic AR/VR simulations
• Active Talks with Microsoft for acquiring Hololens 2, Azure Kinect, and Azure Cloud.
• Active Talks with Oculus Research for acquiring Oculus Rift S and Quest.