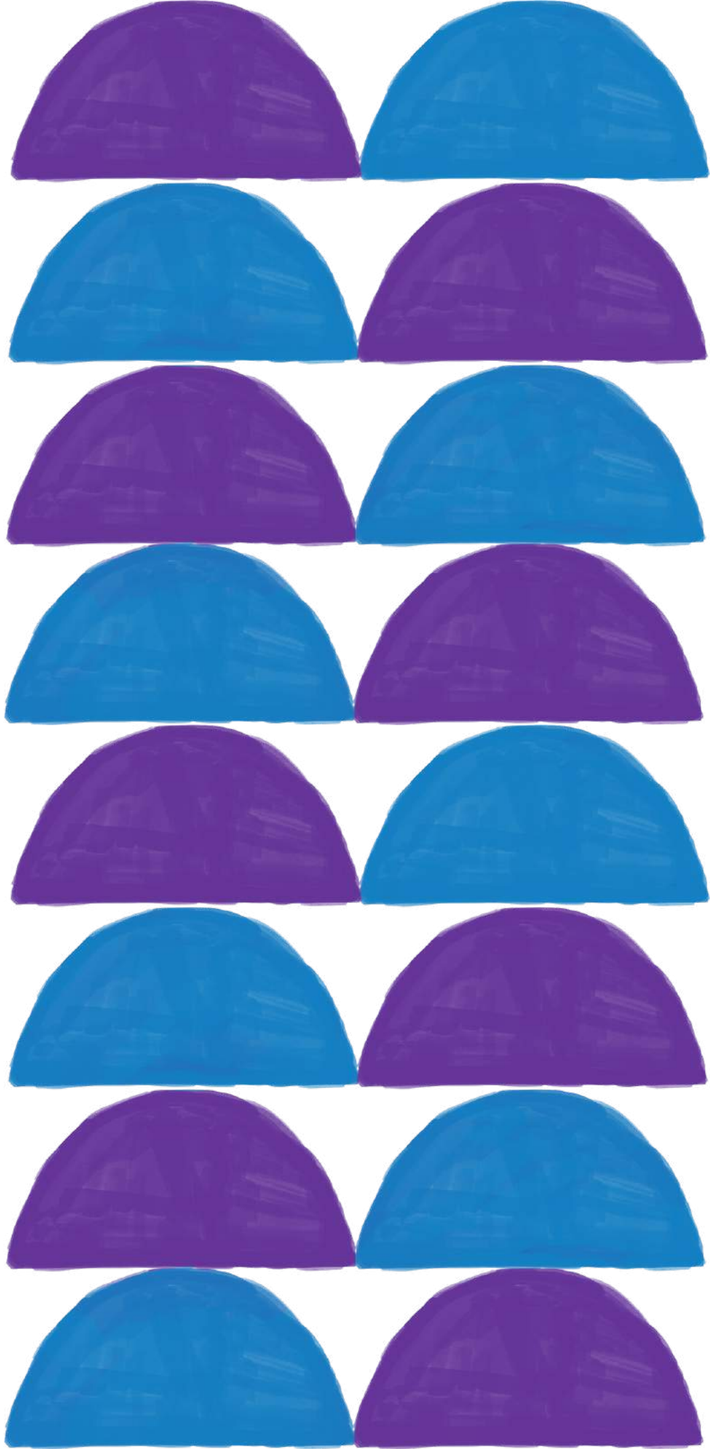
Virtual Reality (VR) Multi-User Lab for Immersive Teaching

Dr Imants Latkovskis & Sarune Savickaite break down development and set up of the lab at the University of Glasgow

Introduction

VR environments provide realistic scenarios and allow the learning of concepts that might be too abstract to explain in only two dimensions, or learning in dangerous (or inaccessible) environments, such as on top of a volcano or inside a human brain.

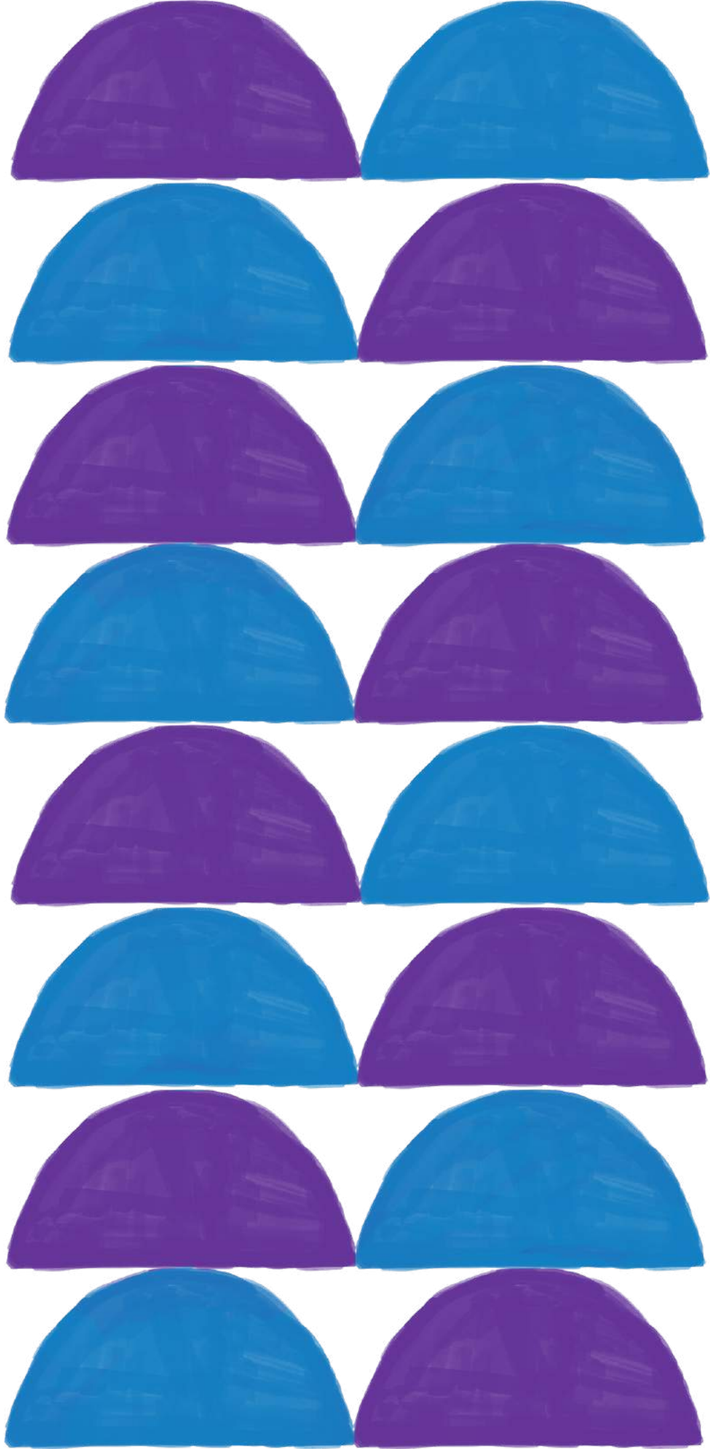
Several studies have found VR immersive learning beneficial (Parong & Mayer, 2018; Lin et al, 2019; Makransky et al, 2019), however, the phenomenon of immersive learning needs to be explored further and different learning strategies disseminated.



Collaborative multi-user VR

Multi-user interaction in virtual environments has always been one of the goals of VR and this has been represented by the tools developed for it. AltspaceVR is just one example of many offering an interactive social space in VR.

To our knowledge, nobody has investigated a multi-user VR room, where users are engaged in the same virtual learning activity, but share a physical space with multiple headsets. Multi-user VR spaces are quite popular in VR arcades, but the concept has not yet been widely adapted for educational purposes.



CENTRE FOR THE STUDY OF PERCEPTUAL EXPERIENCE

PROJECT MOBIUS : EDIFY

Partner: Sublime Digital

Principal Investigator: Professor Fiona Macpherson

Co-Investigator: Dr Neil McDonnell

Funding: Innovate UK funded project (Cost: £911,713, Grant: £716,743)

Duration: 1st October 2018 - 30th September 2021

Key output: edify

Awards:

- Edify is shortlisted in the GESS (Global Education Supplies and Solutions) Education Dubai Awards 2021 in the category of Best Digital/VR/AI Product – a product Neil McDonnell and I developed with company Sublime.
- Professor Fiona Macpherson and Dr Neil McDonnell have been shortlisted in the Knowledge Exchange / Transfer Initiative of the Year category for this year's Times Higher Education Awards, for their work in developing the Edify virtual reality platform in conjunction with local company Sublime. it's deployment of VR-by-proxy was to the benefit of hundreds of students during the pandemic.
- Shortlisted in the University of Glasgow Engagement Awards for in the category of Best Business Collaboration for Project Edify (Fiona Macpherson and Neil McDonnell).
- Finalist in the Scottish Knowledge Exchange Awards Powerful Partnerships category for Project Edify (Fiona Macpherson, Neil McDonnell and Sublime)
- Shortlisted for the Times Higher Education Awards for Technological or Digital Innovation of the Year for the entry:

Project Mobius

- 10 unique VR Teaching Apps for Higher Education
- Unique data and analytics platform
- Immersive Teaching Labs for institutions

- Permanent classroom - Partick Burgh Hall
- Pop-up classroom - Jim's Bar in Queen Margaret Union (work in progress)
- Edify Pods - Alexander Stone Building etc. (work in progress)

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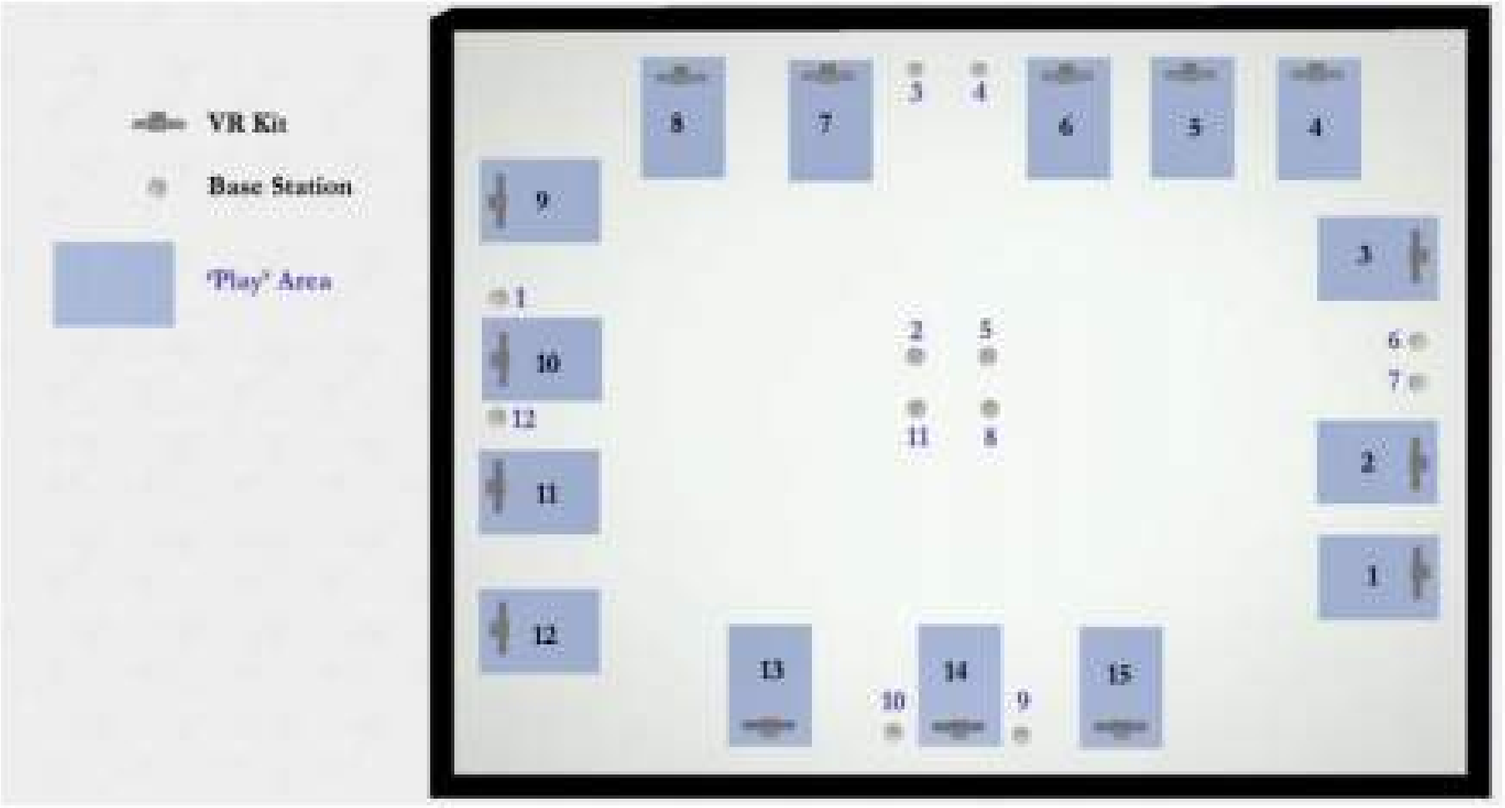
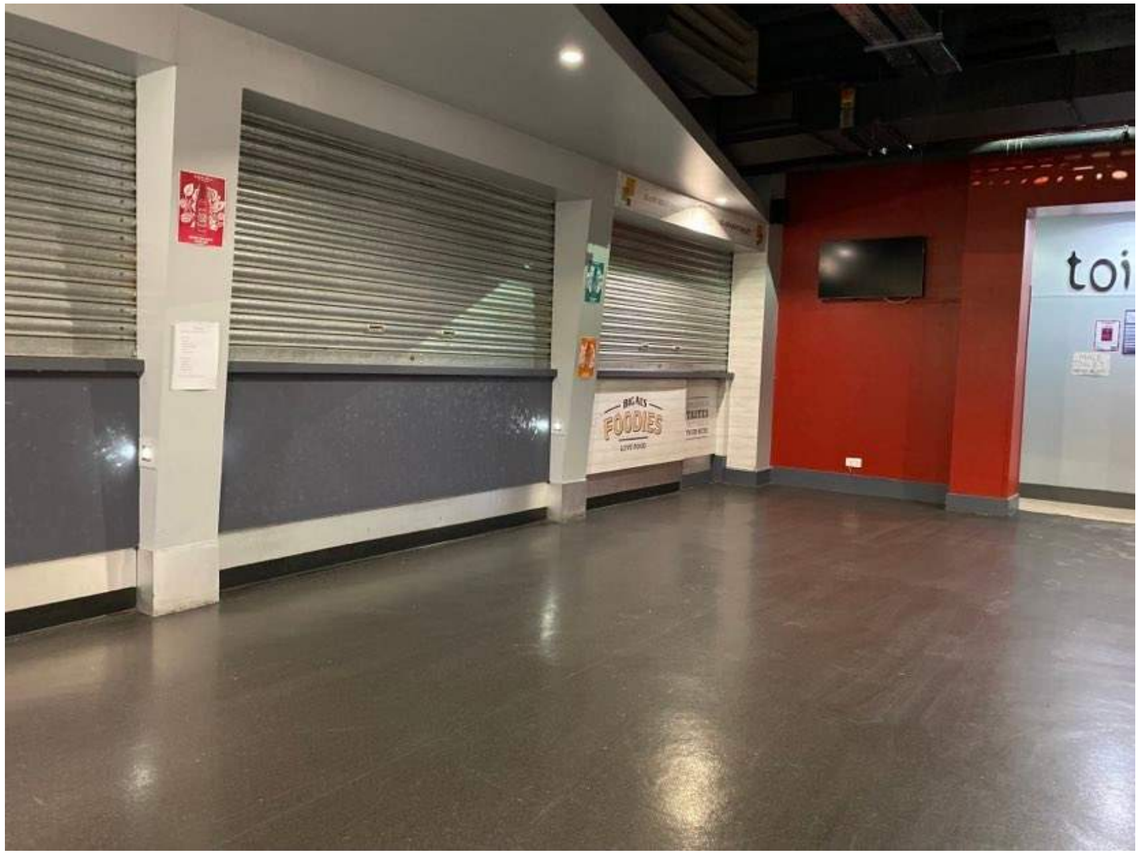
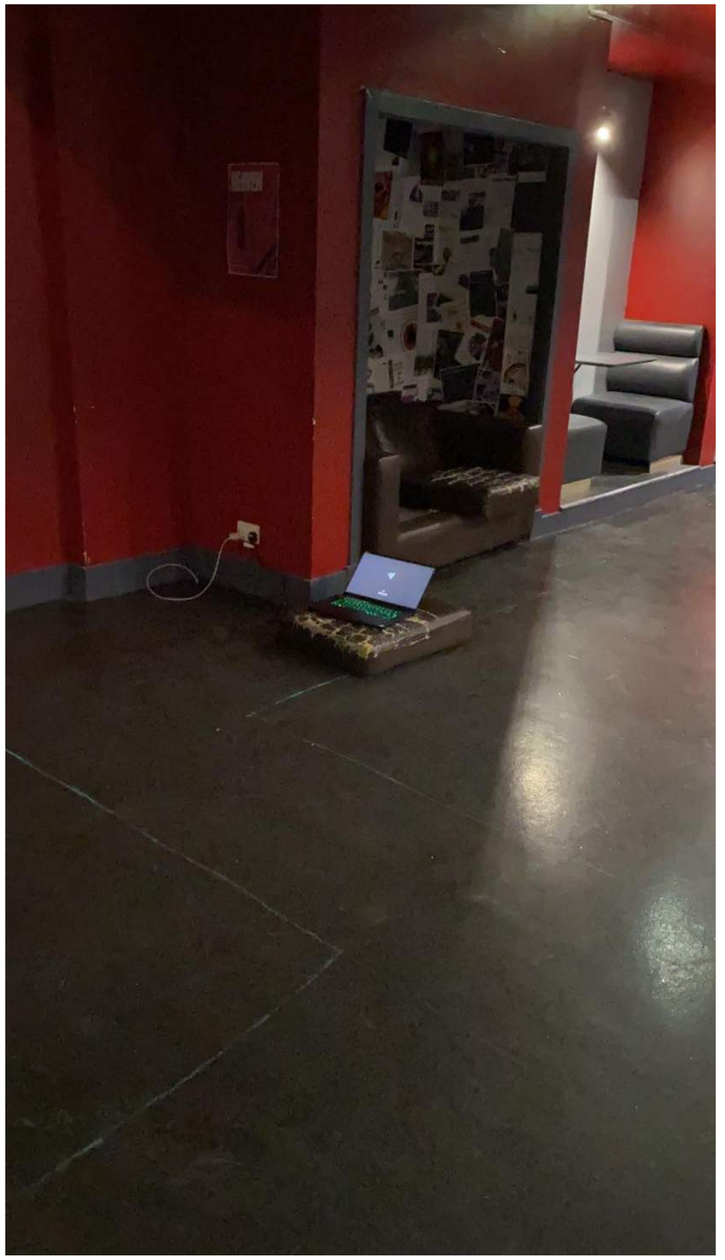

VR Kit
Base Station
'Play' Area
8
7
6
5
4
3
2
1
9
10
11
12
13
14
15


FOODIES



Hardware

- Partick Burgh Hall
  - Dell Precision Towers with Quadro P5000 GPUs
  - Vive Focus 3 headsets in PCVR mode
  - UV Cleanboxes
- Jim's Bar
  - Quest 1's and 2's
  - UV Cleanboxes
- Edify Pods
  - Gaming PCs
  - Vive Pro headsets

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Software

- Partick Burgh Hall
  - TeamViewer
  - Acronis Snap Deploy
  - Faronics Deep Freeze
  - SteamVR
- Jim's Bar
  - Arbor XR

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Edify Pods

- Work in progress
- Aim to get a pod for each of the UofG Colleges
  - College of Art - Alexander Stone Building
  - College of Social Sciences - St Andrews building (TBC)
  - Rest TBC

Next steps for labs

- Overcome pop-up lab deployment issues
  - High-speed beam-formed Wi-Fi router
  - Castable devices
  - Edge computing/cloud streaming to circumvent limitations of standalone VR experience
- Finish setting up Edify pods and train staff on how to use them to raise profile of VR as teaching tool in general and Edify in particular
  - Instructional video in progress
  - School of Education workshop in summer

Exemplar Apps

1. Virtual Printing Press
Students will learn the history of printed word by ‘doing’ in VR

2. VR Molecular Biology
Teaches complex, virtually invisible 3D structures...in 3D!

3. Virtual Basic Physics
Enables core Newtonian lab work to be completed virtually.

4. The Immune System in VR
Students will have a courtside seat for microscopic immune system processes that are opaque & hard to conceptualise.

5. Philosophy: VR Ethical Dilemmas
‘Thought Experiments’ in 3D – tests student’s abstract responses with a ‘real-world’ situation, beautifully simulated

Exemplar Apps

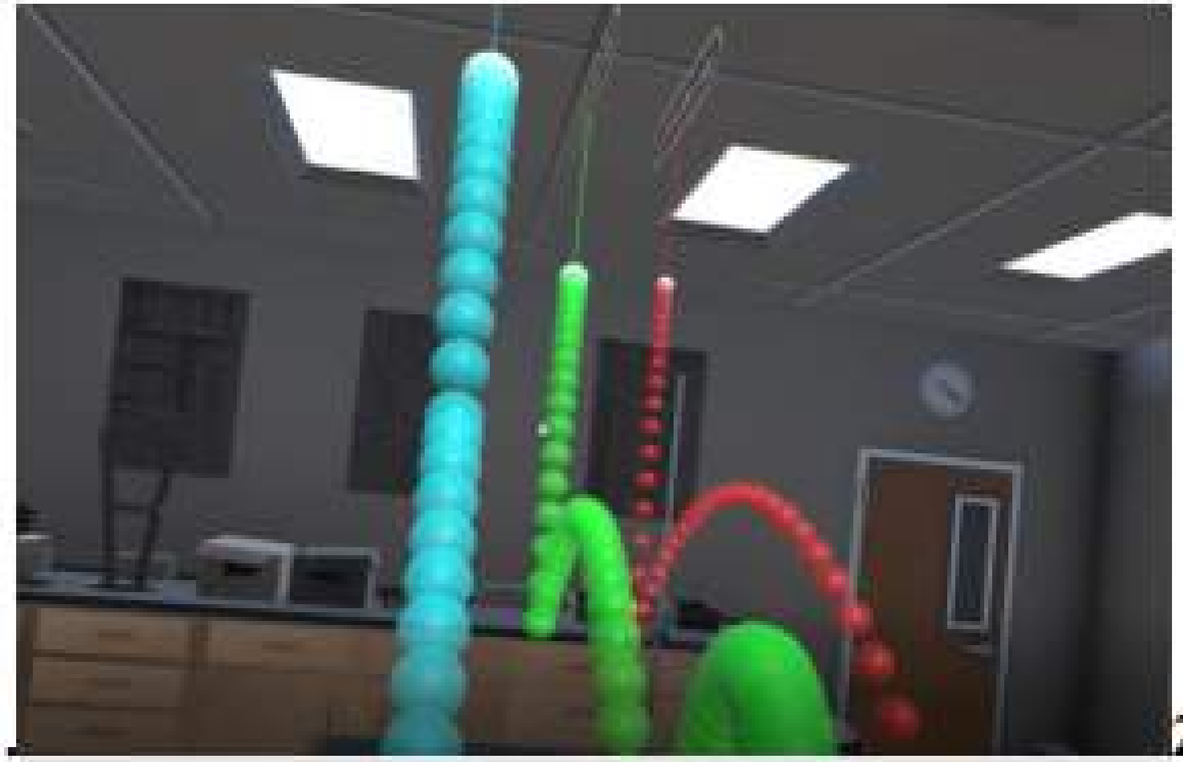
6. Virology Laboratory
Students can analyze virtualized viruses & develop core lab skills

7. Virtual Geology Field Trip
Teachers can ‘take’ students to remote field trip locations instantly

8. Cardiovascular VR
A unique tool, presenting the 3D structure of the heart immersively

9. 3D Data Landscapes
Students can manipulate and analyze abstract data in 3D, significantly improving understanding.

10. The Digestive System in VR
Another court-side seat for a physiological process that is hard to understand, and difficult to teach.

1. 

2. 

Preliminary User Testing

- Exploring the environment. Some apps were explored more than others, for example, Disease Diagnostics vs Printing Press

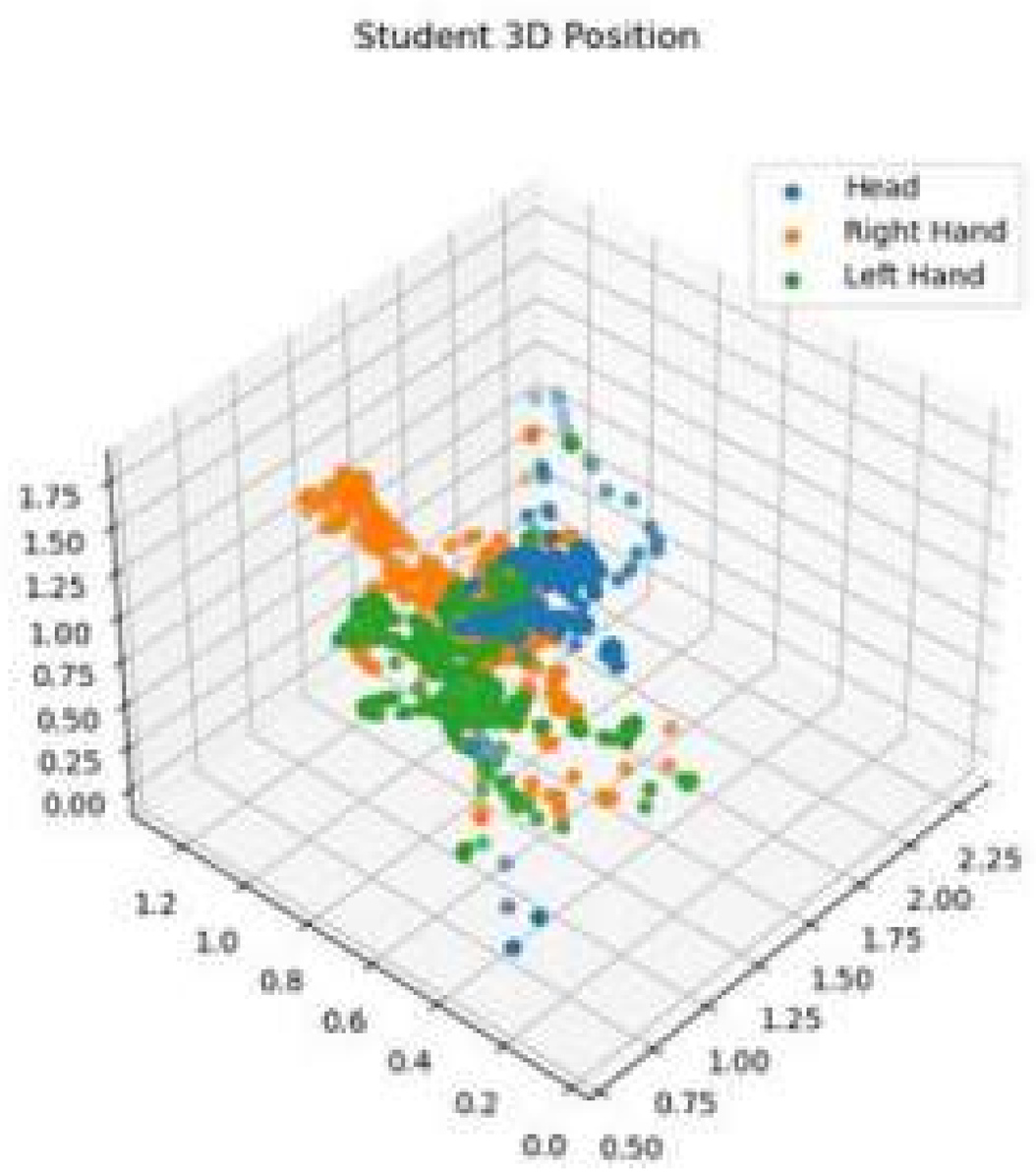
- Instructions were followed easily with a few minor errors. Controllers were used easily with minor errors (e.g. Disease Diagnostics pipetting task)

- Some instructions were a bit wordy (e.g. Physics app)

- Very good feedback was received on the quality of the graphics and the immersion. Some issues with adjusting to the controllers were noted, but these improved with practice

Data Collection

The initial unique data which is available is the student’s position in physical and virtual space. The following examples were collected in the Disease Diagnostics lesson. User interaction data from the Mobius apps can be exported as a .json file and converted to .csv format for further analysis.


Student 3D Position
Head
Right Hand
Left Hand
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25

Next Steps

The next stage of Project Mobius will be to develop the underlying platform that can support such a diverse range of applications and is fit for implementation in higher education. The platform will allow for the development and integration of further apps in the future and will crucially support the capture of anonymised learner data.

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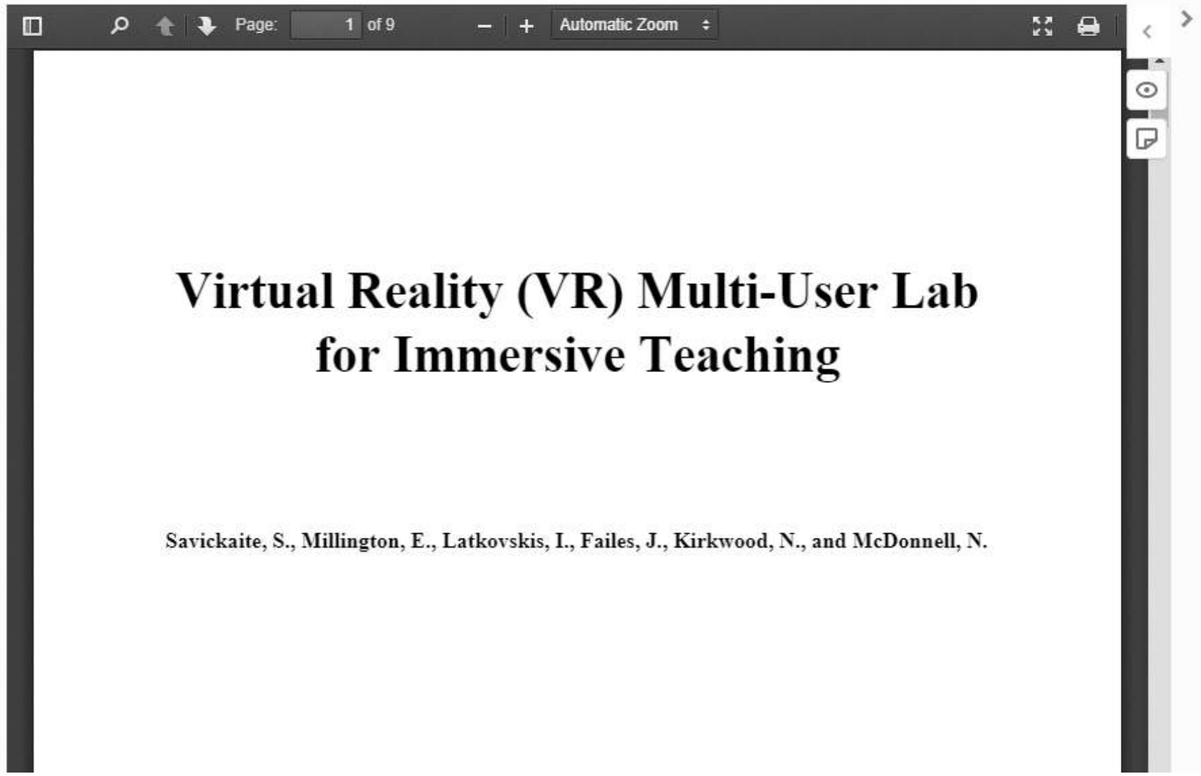
AUTHOR ASSERTIONS

Conflict of Interest: Yes ▾ | Public Data: Not applicable ▾ | Preregistration: Not applicable ▾



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Abstract

As VR technology matures, it offers opportunities to provide state of the art learning experiences. The use of this technology in education is not new, however, it can be significantly improved. Situated (or contextual) learning is one of the key pillars of immersive learning. Multi-user interaction in virtual environments has always been one of ...

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Disciplines

Thank you!

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