Exploratory Investigations of Immersive Digital Reality in Engineering Education

A reflection on virtual reality and initial study outcomes

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Using virtual reality (VR) may have several benefits in the field of trainee education. For example it can allow them to test and deal with experiments that will be part of their future careers. This article explores how to best use VR, specifically the Oculus Quest 2 system, to improve and develop the level of contemporary training and enhance the educational experience.

Introduction

Digital tools based on virtual reality (VR) technologies have seen a remarkable expansion in recent times, especially in terms of the features and characteristics available and their relative ease of use (Wirth et al., 2007). This research article describes how VR equipment was used as a support tool in engineering education to enhance the current learning approach.

The study addressed the following sub-questions in the current work (under the project name 'CarlowENG-VR1.0'):

1. From the students' perspective, what is the effect of using VR on their motivation and engagement?
2. In terms of educational setting and preparations, what should be considered when developing educational programmes that employ VR?
3. What are the additional and unique pedagogical features that VR environments offer?
4. How will VR headsets support learning and the development of attendant exploratory skills, from the students' perspective?

Suggested procedures

Twenty-five undergraduate students from a range of engineering-related programmes, including electronics and aerospace engineering, were notified about this project and invited to participate. To match their profiles, which included electronics and avionics engineering majors, the chosen topic centred on experiments and mission exploration being performed on the International Space Station (ISS) (Gaskill, 2021).

The training session started with a short presentation of basic concepts for graphical user interface (GUI), controller options, and keys. This was followed by an introduction to the different representations which the Mission:ISS software can display. The sequence is shown in Figure 1.

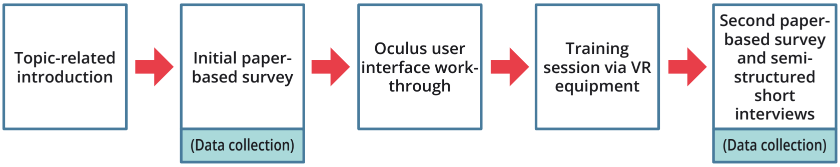

Figure 1: Structure of participants' programme

Results

The results of this research focused on users' opinions in written surveys. The training included a short video explaining what the space surrounding Earth looked like, and an opportunity to look at Earth from the angle of outer space. Participants were unanimous that such immersive technologies for showing educational films were invaluable.

Another question asked students their opinions about the possibilities of including immersive 3D videos in educational programmes in order to encourage people to increase their knowledge of Earth and new space technologies; 76% agreed or strongly agreed, while 20% were neutral (Figure 2(a)).

Watching films with VR or even augmented-reality technologies adds new features to exploring one's surroundings and discovering more precise details. In total, 92% of students classified the 3D-immersive video user interface as very good (Figure 2(b)).

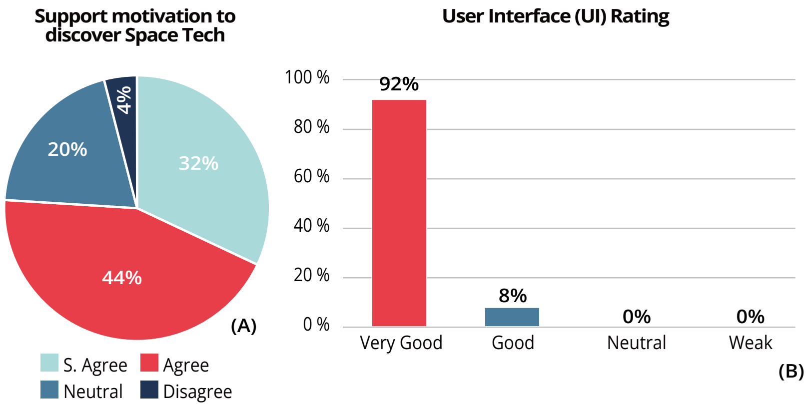

Figure 2: Summary of students' opinions on 3D immersive video

Additional reflections and reactions of trainees were measured based on different question categories (Figure 3), which provided a better understanding of how the training sessions might be developed in the future to ensure that the prescribed learning outcomes are attained.

The paper-based survey indicated that most of the 25 students were highly motivated to work with the Oculus Quest 2 system. Their attitudes to using this kind of immersive learning and interactive training, and integrating them into engineering education, were very positive. Despite their limited prior experience with VR, they were generally confident in their ability to work successfully with rotation, scaling, and navigation features and with other options and parameters of the Oculus system (Figure 3(a)).

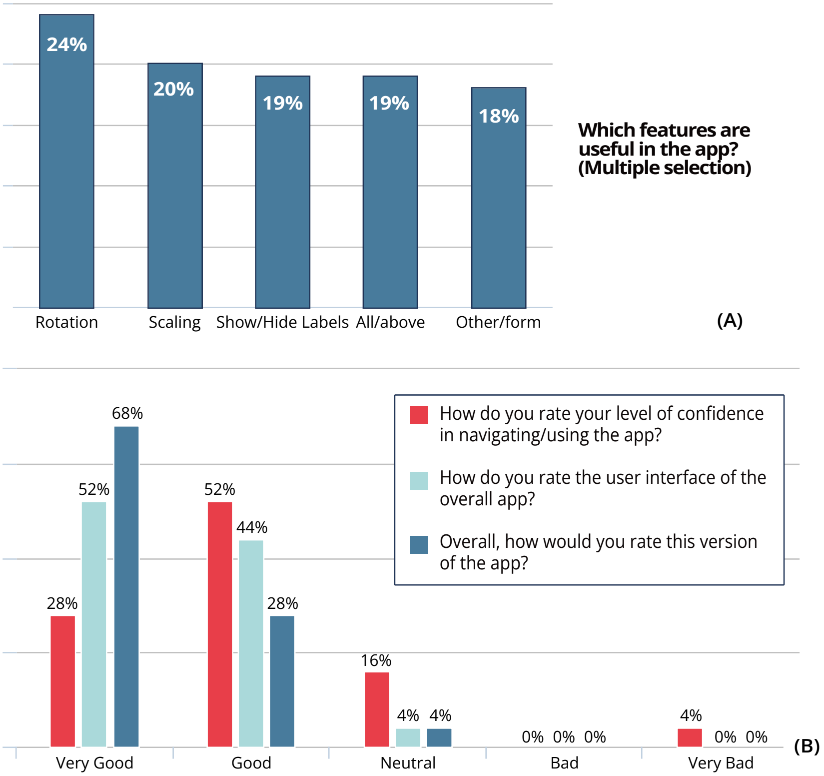

Figure 3: Summary of users' responses after testing the Mission:ISS software via VR headset

Students' attitudes to VR applications were also positive (i.e., good or very good) (Figure 3(b)), with a mean score of 8.1 on a 1–10 scale.

Conclusions and proposed future goals

These kinds of training techniques and high-tech research using digital reality can increase knowledge creation and awareness by sparking learners' imagination, and supporting them to experience learning such as testing partial zero-gravity in the ISS, which would not have been otherwise accessible to them in the classroom.

Until the current study, there were a limited number of studies on embedding VR techniques in teaching engineering in Ireland. This research offers new findings that may be applicable to higher education in general or to engineering fields specifically. Mainly, the results show that potential students or trainees are supportive of integrating VR technologies and related equipment in higher-education programmes, especially as support tools in the laboratory.

The use of immersive and smart technologies in education promises many benefits for learners and educators.

Nowadays, digital reality equipment seems relatively costly, especially when needed for all students to use simultaneously in a teaching session, which might mean it is unsuitable to scale up. However, creating innovative teaching or training sessions with continuous enhancements and additional improvement, such as the adoption of digital reality devices, could make its overall use in educational environments more sustainable.

This research study can open doors for new ideas and project proposals to enhance undergraduate engineering education supported by immersive technologies. This would be the case, for example, in the work required to develop the strategic concepts to design and implement a mixed-reality environment for electronic engineering applications, such as on hands-on Arduino electronic board courses or modules. Microcontrollers such as Arduino form part of the curriculum on several programmes, and students on these programmes in South East Technological University (SETU) have the chance to learn related concepts and to work on basic projects.

The suggested methodology deals with some current problems of learning and teaching with immersive technologies, such as how these technologies can support learning, how to systematically design immersive systems, and how to increase the efficiency of composing immersive learning applications.

What is unique about the first level of this new and proposed platform lesson is that students are immersively learning the Arduino micro-controller architecture and all electronic board properties and pin configurations of the microcontroller and related characteristics (for different kinds of Arduino versions), as illustrated by the instruction sets, based on simple programmes for different scenarios (Figure 4(a)).

As well as learning how to assemble the electronic board by following side-by-side virtual board instructions, students can follow these instructions on the physical board assembly. There are also opportunities to integrate educational tools, such as Arduino Simulator, which can help in advanced Arduino simulation based on mixed reality (Figure 4(b)).

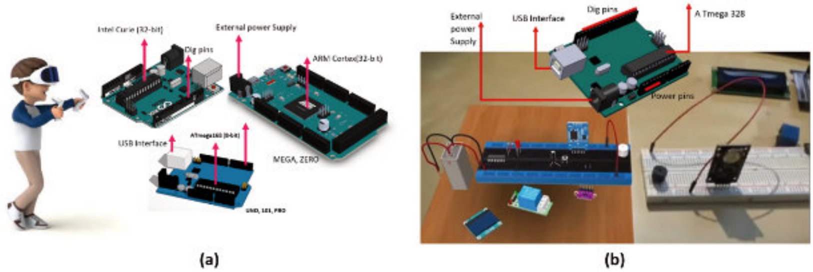

Figure 4: Principles of suggested two levels of educational immersive system

The use of immersive and smart technologies in education promises many benefits for learners and educators. However, many studies have shown that the success of every learning environment based on new technology depends on its design and integration in the learning process (Aljagoub & Webber, 2022). The proposed framework emerging from this study could present a holistic approach to integrating intelligent and immersive environments in engineering education, as shown in Figure 5.

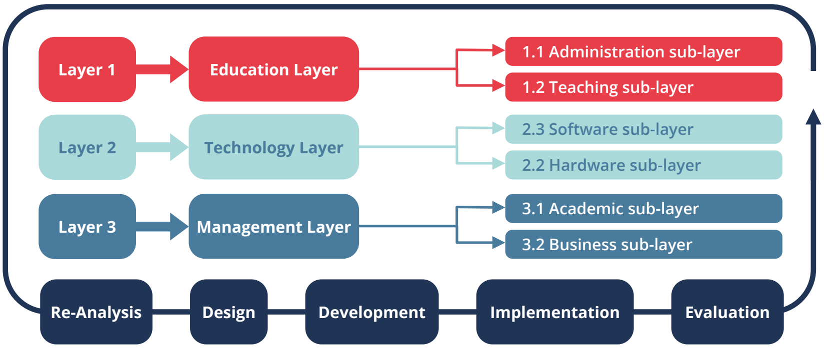

Figure 5: Suggested methodology for integrating smart and immersive environments in engineering education (Al-Kishali & Al-Juboori, 2003; Al-Juboori, 2012)

This approach would allow educators to examine the use of immersive technology from different angles. The framework deals with the interplay between the three layers – education, technology, and management – and emphasises how technology influences the traditional instructional design and management processes (Figure 5). In other words, the presented framework builds on the educational life cycle, which can help provide a structure and guidelines for educators to plan and implement an educational programme based on immersive and smart technologies.

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U.S. Company Signify Health collaborates with University of Galway on new case study for Business syllabus

A case study examining the business strategy behind Signify Health's decision to open its first overseas hub in Galway is to become part of the syllabus for students based in third-level institutions around the globe.

Signify Health is a healthcare services company using advanced technology and data analytics to enable value-based care in the U.S. healthcare market.

Some 80 people in technology innovation roles have been recruited in Galway, with recruitment continuing. The team in Galway is creating tech solutions for some of the biggest challenges in the U.S. healthcare system.