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EXPLORING THE USE OF IMMERSIVE TECHNOLOGIES TO ENHANCE THE STUDENT EXPERIENCE

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Abstract

This paper reports on the initial phase of a National Forum funded Learning Enhancement Project (LEP), under the Strategic Alignment of Teaching and Learning Enhancement (SATLE) funding stream. The purpose of the LEP is to explore the use of immersive technologies such as Augmented Reality, Virtual Reality and 360° Learning in three key domain areas within one higher education institution in Ireland. While significant research has been conducted into the use of these technologies in training and business contexts, the application and use in higher education is still scarce. Radianti et al. (2020) suggest that while the use of virtual reality in higher education is promising, it is still quite experimental and focuses more on performance and usability than learning-oriented applications. Augmented Reality has been used in areas such as teacher education (Sáez-López, 2020) and EFL (Arkipova, 2022) but is also largely experimental. Together with Mixed Reality and 360-degree Learning, these technologies have the potential to offer students a more immersive learning experience. Three domain areas are involved in this project: Online Learning; the university library; and the academic discipline of Business Tourism. It is envisaged that based on their expertise and experience team members will trial at least two of the immersive technologies with their students during the academic year 2023-2024. Engaging the students in the research will foster a partnership approach and provide an understanding of how this new approach to learning benefits the students but will also reveal the challenges associated with introducing new technologies.

Keywords:

Virtual reality, augmented reality, immersive learning, 360-degree learning, higher education.

In line with the ambition of the theme of Digital Transformation in the Irish Tertiary Sector, promoted by the National Forum for the Enhancement of Teaching and Learning (2023), this project seeks to examine how immersive technologies can be used within a variety of contexts to enhance the student learning experience.

Significant research has been conducted into the use of immersive technologies in the domains of Engineering (Fracaro et al., 2022; Halabi, 2019) and Medicine (Dhar et al., 2021; Pottle, 2019; Tang et al, 2022) in particular. However, their wider application and use in HE is still evolving. According to Radianti et al. (2020), while the use of virtual reality in higher education is promising, it is still quite experimental and focuses more on performance and usability than learning-oriented applications. Augmented Reality has been used in areas such as teacher education (Sáez-López, 2020) and EFL (Arkipova, 2022) but is also largely experimental. Together with Mixed Reality and 360o Learning, these technologies have the potential to offer students a more immersive learning experience.

As far back as 1994 Milgram and Kishino presented a reality-virtuality continuum (Figure 1). Here the authors distinguish between the real environment and the virtual environment and attempt to provide a taxonomy of the main aspects of each class.

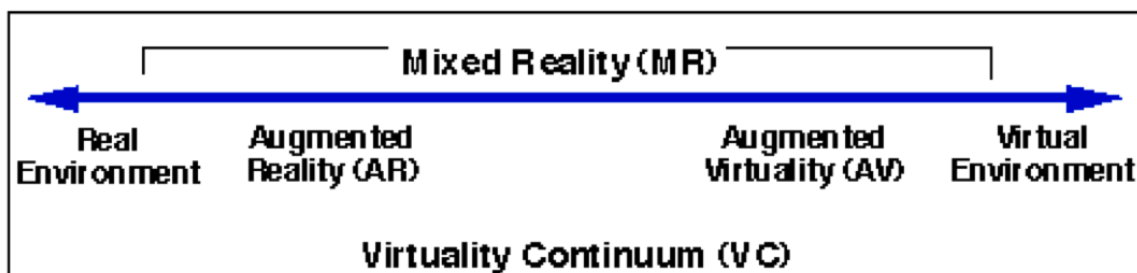


Figure 1: The Simplified representation of a "virtuality continuum" (Milgram & Kishino, 1994, p.3)

This taxonomy provides a simple visualization of the relationship between the different environments. Virtual Reality allows users to enter a virtual world, removing them from their physical surroundings. Using a Head-Mounted Device (HMD), users immerse themselves in a different, computer-generated environment. The terms Mixed Reality and Augmented Reality are often used interchangeably, with both extending the physical world, augmenting reality with digital information. However, Milgram and Kishino (1994) consider the former as an overarching term to describe the 'grey area' in the centre of the continuum (p. 4). More recently 360-degree video is often listed alongside these immersive technologies. While 360-degree video differs from virtual reality in providing the learner with 360-degree videos stitched together from a series of two-dimensional images taken from different angles, it provides the user with a similarly interactive learning experience.

Immersive Learning

The potential of immersive virtual reality to enhance learning was explored by Coban et al. (2022) in a meta-analysis of 49 articles, where the authors conclude that "teaching based on VR technologies is more effective than other environments" (p.11). They determine that immersive VR facilitates "inquiry-based learning and a constructivist learning approach" (ibid), though they specify that this is more prevalent in K-12 education based on their research. In higher education the benefit of VR is particularly notable in simulation-based teaching and learning contexts, where students could use equipment in a virtual context before working with it in a laboratory environment.

Rogers (2019) describes VR as the learning aid of the 21st century, while Krokos et al. (2018) found that VR using HMDs showed an improvement in recall accuracy when compared to a similar desktop activity. 40 participants took part in the experiment which showed 42 faces in two scenes and were invited to familiarize themselves with the faces. The improvement in recall performance was 8.8% higher in the use of HMD compared to the desktop version and the authors concluded that memory recall could be enhanced through immersion in a virtual environment.

Marks & Thomas (2021) document the use of virtual reality for higher education (HE) teaching in a purpose-designed laboratory and conclude that there was a clear need for a pedagogical framework which would allow for "experiential and discovery learning, reflective observation, abstract conceptualization and active experimentation" (p.1302). They also advise that in-house content creation support is important, but with appropriate educational frameworks. The authors report that some students experienced discomfort using the VR technologies, citing motion sickness and difficulty navigating the content. However, most students surveyed in the study said they would like to use VR technology again.

A learning model which considers both Human-Computer Interaction and pedagogy was developed by Zhou et al. (2018) to explore how Bloom's Taxonomy, together with the Technology Acceptance Model (TAM) might be used to evaluate student learning with VR in skills training and operational learning. Following their survey of 32 students, they concluded that the learner experience was positive, with both flow and positive affect scoring highly, while tension, annoyance, challenge, and negative affect scored low. While it is acknowledged that this is a small-scale study, the combination of HCI and pedagogical models reflects the widely held opinion that an

educational framework is needed to guide the implementation of immersive technologies within the curriculum to support learning.

The benefits of AR within the education setting have also been well-documented. Findings from research suggest that using AR improves students' motivation (Irwanto et al., 2022), engagement and student satisfaction (Saltan & Arslan, 2016), learning performance and learning experience (Akçayır & Akçayır, 2017). However, research conducted by Zumbach et al. (2022) compared AR-based learning environment with a paper-based learning environment for participants to learn about the human digestive system. They concluded that the positive effects of AR were limited to a higher experience of immersion. However, in terms of learning gains, the paper-based instruction showed significantly higher results. Buchner and Kerres (2022) argue that the research on AR has to date focused primarily on comparing AR to other technologies. In a meta-analysis of 92 primary studies, they note that many of the studies compare AR to traditional and established media focusing on a "technology-centred understanding of teaching and learning, while ignoring the theories of learning and instruction.

The current project aims to address this deficit to explore how AR/VR and 360-degree video might enhance the student experience, through the integration of immersive technologies into the curriculum. It also responds to the Next Steps Report from the National Forum (2021), which advocates a reimagining of our learning environments to support "diverse approaches to teaching, learning and assessment" (p.12).

Research Design

A qualitative approach to the research has been chosen to explore student and teacher experiences of immersive technologies within the curriculum. The key research question which guides this study is:

To what extent can immersive technologies such as AR/VR and 360-degree learning enhance teaching and learning in higher education?

While many of the studies cited above include quantitative approaches, the desire to understand in detail students' perception of AR/VR/MR provided a rationale for a qualitative research design. Three key student/teacher cohorts will be included in the research, as outlined below.

Business Tourism students on two academic programmes will be offered the opportunity to experience an immersive learning environment. The students involved will be given the opportunity to experience immersive technologies in a professional context. The project aims to encourage students to consider the application of immersive technologies in a professional context and will also demonstrate their knowledge of these relatively new technologies which are increasingly used in many professions such as Tourism (Londoño, 2022). However, to examine the potential of the immersive technology tool for teaching and learning, the lecturer-researcher will align the activity to at least one learning outcome within each academic programme. To guard against the novelty effect (Wells et al., 2010) and to encourage students to engage in a meaningful way with the immersive technologies, the selection of one learning outcome for each of the academic domains will provide a focus for the student participants. The resources chosen by the lecturer-researchers will be relevant to the selected learning outcomes and may be of benefit to students for the assessment of these learning outcomes.

Immersive pedagogy (Gauthereau et al., 2020) is a creative, active teaching and learning approach which puts the student at the centre of the learning experience, developing critical thinking and problem-solving skills. The approach adopted by teacher-researchers for this project will be informed by current research in immersive pedagogy.

This project will also focus on the potential to enhance the educational environment for students studying an online programme. The growth of online teaching has also been well-documented in academic research to the extent that Palvia et al. (2018) contend that online teaching will become mainstream by 2025. The growth in online enrolments cannot be separated from the development of technologies such as VR/AR which enhance what can be delivered, either via synchronous or asynchronous modes. Immersive technologies offer a variety of means of engagement between teachers (including HE lecturers) and students. This responds to the

expectations on the part of students for the use of technology-enhanced learning and teaching methods has increased (Ashour, 2020). In this instance the teacher-researcher will evaluate the use of at least one approach with adult, part-time learners on an online business programme. The use of immersive technologies will be evaluated to consider the Quality of the User Experience (Keighery, 2020), as well as the potential Learning Gains (Evans et al., 2018). The Next Steps report also recognises the need to cater for our “increasingly diverse learner profiles” (p. 12). Immersive technologies offer a multimodal approach to learning, engaging all the senses in the learning experience and cultivating a more inclusive learning environment.

Additionally, collaboration with the university library will provide an opportunity to explore how immersive technologies might enhance student engagement with the library. According to Greene (2020), several libraries are now offering AR/VR services to their students, both in-library and as a service to academic faculties. The potential to design experiences through the creation of content (e.g., 360-degree video or AR-based library tours) will be explored as part of the research project.

Finally, this cross-campus collaboration builds on current work in immersive technologies already underway within the university. The development of a Community of Practice of researchers and practitioners in immersive technologies will encourage academic and professional staff to combine knowledge and expertise to create further opportunities for teaching and learning in this domain.

Conclusion

Outputs from this funded project will include a comprehensive literature review on the use of immersive technologies in higher education; a proposed pedagogical framework for using AR/VR/MR/360-degree learning within the curriculum, and an evaluation of the research project, with student and teacher-researcher input.

This project does not just focus on the use of immersive technologies. Its purpose is also to explore how immersive technologies can contribute to a more immersive, multimodal, inclusive educational experience. As these technologies become more affordable and more robust, they offer greater potential for our educational context. It is hoped that the learning from this project will inform further research in this area.

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