Immersive Technology in Education

Bosman, Isak de Villiers University of Pretoria, South Africa | isak.bosman@up.ac.za
Smith, Annique Elizabeth University of Pretoria, South Africa | annique.smith@up.ac.za
Wong, Yan Lau University of Pretoria, South Africa | yan.wong@up.ac.za
Ka, Kwan Sui Dave University of Pretoria, South Africa | dave.ka@up.ac.za
Alemneh, Daniel University of North Texas, USA | daniel.alemneh@unt.edu
Chow, Anthony San José State University, USA | a.chow@sjsu.edu

ABSTRACT
Immersive technologies like virtual reality (VR) and augmented reality (AR) are transforming higher education by providing engaging, experiential learning opportunities. However, their integration into educational practices presents challenges, including high costs, technological complexity, and the digital divide. This panel explores the application of immersive technologies in higher education, focusing on developing an immersive technology lab designed to support their adoption across the institution. The discussion will cover global perspectives on immersive learning, showcasing varied adoption rates and strategies across different regions. Additionally, the panel will highlight research opportunities in immersive education, emphasizing the need for studies on effective integration, impact on learning outcomes, and strategies to overcome barriers to adoption. The goal is to identify sustainable approaches to expose staff and students to immersive technologies, ensuring equitable opportunities for all stakeholders.

KEYWORDS
Education; Extended Reality; Immersive Technology; Virtual Reality; Augmented Reality

INTRODUCTION
With the advent of technologies that offer new ways of immersing users in virtual environments, there has been a significant uptake in immersive technologies in the last decade. Companies like Meta (formerly Facebook), Google, and Apple have invested heavily in the development of virtual reality (VR) and augmented reality (AR) technologies (de Regt et al., 2020) and the market for such products is estimated at several billion USD (Statista 2024). These technologies, which have come to be known as eXtended reality (XR) technologies collectively, are typified by their ability to create the illusion of media-generated realities that blend with physical reality in varying degrees (Laato et al., 2024). We can formulate their distinctive properties in terms of their ability to generate three unique illusions: that of occupying a different place than where one is physically located, of experiencing digital phenomena as actually occurring, and of inhabiting a virtual body (Slater et al., 2022).

Most immersive environments require some form of interaction from the user, making them effective in educational settings that foreground the principles of constructivist learning (Kavanagh et al., 2017). In these environments, students can freely explore the virtual space, and engage in experiential learning (Mahmoud et al., 2020), making this a student-centered teaching method involving active learning. This active learning is also what makes immersive technologies well-suited for teaching procedural or practice-based knowledge as opposed to declarative knowledge (Radianti et al., 2020). Existing studies in this area involve using immersive technologies in STEM fields to allow students to engage with learning content directly, thus improving their understanding (Pellas et al., 2020; Roopaei and Klaas, 2021). Immersive technology has also been used in conjunction with language learning to lower student anxiety and offer an authentic space in which to practice (Dhimolea et al., 2022).

Immersive technologies offer several potential advantages in education contexts. It has been linked with desirable outcomes, such as higher levels of motivation, interest, and self-efficacy (Lawson and Martella 2023; Mayer et al 2023), and can realistically expose students to scenarios they might not otherwise have access to or that might be dangerous (Roopaei and Klaas 2021), for example medical or engineering training. Conversely, these technologies can be very costly to use in educational settings, thus exacerbating the digital divide. Since the technologies are still in a relatively early stage of adoption, their novelty or perceptual richness might distract students from their learning outcomes (Mayer et al 2023). Their introduction could also introduce extra cognitive load as students would need to learn to use the technologies first, before being able to use them to achieve their goals (Bosman et al. 2023).

Despite the increasing popularity of these technologies in education, their adoption into mainstream education is relatively slow (Estrada and Prasolova-Førland, 2022). What remains unclear is how staff and students, specifically at a higher education level, can be exposed to this technology sustainably, ensuring fair opportunities for all stakeholders. Subsequent investigations into integrating such technologies within educational settings may investigate efficacious approaches for incorporating immersive technologies across diverse academic fields, evaluate their enduring influence on educational achievements, and tackle the obstacles associated with expense, ease of use,

and mental strain. This panel seeks to explore the use of immersive technology in higher education, focusing on the recent development of an immersive technology lab at a higher education institute, to support the adoption of this technology into teaching and learning practices.

This immersive technology lab is equipped with seven dedicated areas that allow visitors (students, researchers, staff) to engage in various virtual experiences so that they can become familiar with this technology with regards to its capabilities and limitations. Three of these dedicated areas use standaloneVR technology (Meta Quest 3 headsets). Visitors can use the technology to engage with some commercial experiences such as 360° videos for viewing natural and historical landmarks, interacting with digital art exhibitions, and playing games. Games are specifically provided because they are not only appealing to students, but these experiences are inherently interactive (Oyelere et al., 2020) and are, therefore, a good way to expose visitors to a range of existing methods for interaction techniques used for VR. For visitors with a programming background, there are also three dedicated VR development rooms where they can use the VR equipment to learn and practice designing and developing VR experiences. There is also one development space equipped with AR technology. These technologies are becoming increasingly popular worldwide, while their uptake varies by location. Furthermore, to ensure equitable opportunities for all stakeholders in higher education settings, research on sustainable strategies to introduce staff and students to immersive technology is needed (Estrada and Prasolova-Førland, 2022). The lab facilitates equitable opportunities by offering exposure to XR technologies for visitors (students and staff alike) across various socio-economical backgrounds as long as they are a members of the higher education institute that hosts this facility. Outside of this lab, opportunities to engage with these technologies are usually limited because of their expense, and not many commercial experiences offer space to engage with design and development for VR. Offering these opportunities to visitors of the lab can expose them to immersive technologies and provide a foundation for needing to work with these technologies in industry and research.

PROPOSED FORMAT AND PANEL ORGANIZATION

The envisaged panel will be approximately 90 minutes long. This panel includes academics from a diverse range of backgrounds regarding technology, education, and information science. The panel will follow the structure outlined below:

Introduction. Isak de Villiers Bosman (4 minutes)

Theme 1. What is immersive technology: Isak de Villiers Bosman (6 minutes)

Theme 2. Immersive technology in education to improve student learning. Yan Wong (4 minutes)

Theme 3. Case study: immersive learning for hazard detection in mining engineering. Yan Wong. (4 minutes)

Theme 4. Practical implications of an immersive tech lab at a university. Dave Ka. (4 minutes)

Theme 5. Global Perspectives on Immersive Learning. Daniel Alemneh (4 minutes)

Theme 6. Research Opportunities in Immersive Education. A. Chow. (4 minutes)

Breakout group for each theme. (25 minutes)

Feedback and discussion. Group leaders. (25 minutes)

Summary and conclusion. Moderator: Isak de Villiers Bosman (10 minutes).

ENGAGEMENT WITH THE AUDIENCE

After the presentations, the moderator and panelists will divide the audience into six sub-groups (one group per theme), inviting them to share their ideas, experiences with related research, relevant theories, and methodologies (25 minutes). To promote discussion, prompts will be given based on concepts identified in Theme 1, such as technological advantages and limitations of immersive technology and future directions. Each group will nominate a person to give feedback. This feedback from the six groups will take an additional 25 minutes. Audience input will be summarized by the moderator and briefly shared with the audience in a 10 minutes summary discussion, as well as via email.

EXPECTED OUTCOMES

By the end of the panel discussion, the audience will have increased their knowledge and understanding of immersive technologies as a whole and their benefit in teaching and learning. Concrete suggestions for the development of immersive technology labs will also be given based on practical experience. It is envisaged that the discussion from this panel will provide the foundation for other institutions to also begin adopting immersive technologies in their teaching processes and approach this from a position of fostering not only competency but also responsible applications of the technology in real-world contexts.

RELEVANCE TO THE 87TH ANNUAL MEETING OF THE ASSOCIATION FOR INFORMATION SCIENCE AND TECHNOLOGY

This panel aligns with the theme of the annual meeting namely "Putting People First: Responsibility, Reciprocity, and Care in Information Research and Practice" by discussing the use of emerging technologies in a student-centered learning context. By framing the application of immersive technologies with students' goals and needs as a core concern, we aim to shift the focus from one which is usually technology-centered, to a student-centered approach which seeks to align the adoption of new technologies with the specific needs of the student population.

PANEL MEMBERS AND MODERATORS

Isak de Villiers Bosman is a Lecturer in the Department of Information Science at the University of Pretoria, South Africa and a PhD student with the Gamification Group at Tampere University, Finland. His research focuses on the use of sound in virtual reality and its effect on user experience.

Annique Elizabeth Smith is a Lecturer in the Department of Information Science at the University of Pretoria. She is also a PhD student at Tampere University, with the Gamification Group. Her research focuses on the use of gamification in student-centered learning environments, specifically involving metacognitive reflection.

Yan Wong is a Lecturer in the Department of Information Science at the University of Pretoria. He has just completed his master's study creating a virtual reality serious game teaching hazard detection in mines. Yan's research primarily focuses on the application of game design techniques in game-based learning to improve the teaching effectiveness of such tools.

Kwan Sui Dave Ka is a Lecturer in the Department of Information Science at the University of Pretoria. He has recently completed his master's study in using proprioception to support menu item selection in virtual reality. Dave's research is primarily focused on interaction design for virtual reality experiences and has a particular interest in improving accessibility in virtual reality experiences for people who struggle with motor disabilities.

Daniel Alemneh is head of the Digital Curation Unit at the University of North Texas Libraries and teaching at the College of Information. For the past 20 years, Dr. Alemneh has been actively involved in various professional activities including being a member of ASIS&T and ICKM Board of Directors. He is a Research Associate of the Department of Information Science, University of Pretoria and in 2022 he was a Fullbright Scholar in that Department.

Anthony Chow is a Full Professor and Director of the San José State University School of Information and has been working with and studying XR in education and library settings for the past 25 years with a focus on human cognition and UX. He is the founder of SJSU's Library Technology Integration Lab which conducts research and development and provides hands-on learning experiences with emerging technologies including VR, MR, and AR. Dr. Chow is also co-founder and co-director of Seeking Immortality, which is an IMLS funded digital preservation project with the Northern Cheyenne that is preserving aspects of their language and culture and presenting them in an immersive VR environment.

GENERATIVE AI USE

We confirm that we did not use generative AI tools/services to author this submission.

AUTHOR ATTRIBUTION

First author: conceptualization, writing – original draft, writing – review & editing; Second author: conceptualization, writing – original draft, writing – review & editing; Third author: conceptualization, writing – original draft, writing – review & editing; Fourth author: conceptualization, writing – original draft, writing – review & editing; Fifth author: writing – original draft, writing – review & editing; Sixth author: writing – original draft, writing – review & editing

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