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Navigating the Terrain:

Emerging Frontiers in Learning Spaces, Pedagogies, and Technologies

Enhancing Clinical Education Training with Immersive Reality (XR)

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A core element of clinical education is the observed structured clinical examination (OSCE) that simulates real-life clinical practice. These OSCEs can be enhanced through combining the best elements of emerging technologies in the design of enhanced simulation environments to prepare healthcare graduates for changing clinical practice as it integrates new and emerging technologies. New and emerging immersive reality (XR) headsets that allow digital enhancement of practice with real tools and procedures can be combined with haptic feedback such as a high-fidelity manikin within an interactive immersive room that can replicate a wide variety of real-world scenarios at the touch of a button. In this way XR can enhance authentic learning in clinical and first responder practice by enabling exposure to critical elements of clinical simulation in a safe, contextual learning environment that is cost effective and scalable compared to the expense of simulations involving actors and physical real-life sets. In response this concise paper introduces the development of a framework for enhanced simulation practice using the Blended Learning Simulation Suite (BLISS).

Keywords: Immersive Reality, Simulation, OSCE

Introduction

OSCE's are a foundation of clinical healthcare education (Rushforth, 2007) but due to time and resource-intensiveness often lack elements of critical authenticity. This project aims to address the gap in clinical healthcare education that prepares practitioners for real-world environments and develops their ability to critically evaluate best practice in stressful environments. The project will develop a scalable and transferable framework for designing and evaluating the effectiveness of authentic healthcare simulation learning environments using immersive reality (XR).

Building on the MESH360 project

Established in 2016 the Multiple Environments Simulation Hub (MESH360) project to explore ways of making critical care simulation environments more authentic learning experiences for students (Cochrane et al., 2016). Through three DBR research cycles (Aguayo et al., 2021; Cochrane et al., 2020; Cochrane et al., 2019) the

MESH360 project developed a framework for designing authentic learning scenarios using immersive reality in paramedicine clinical simulations.

Theoretical Foundations

Reviews of the literature identified several gaps in the research surrounding the use of immersive reality in clinical health higher education (Aiello et al., 2023; Stretton et al., 2018; Stretton et al., 2024). Most case studies reported in the literature are non-longitudinal case studies, and the focus of the case studies is predominantly creating student competency for a specific medical procedure. The systematic review also identified that there is generally little reported evidence of engagement with learning theory in the design of VR clinical simulation education scenarios. Our development of XR enhanced simulation training draws upon learning theories and learning design frameworks that focus upon designing authentic learning and team-based transformative learning experiences.

Authentic Learning and the MESH360 Framework

Authentic learning draws upon learning theory such as social constructivism, constructionism, self-determined learning, and embodiment (Aguayo et al., 2021). This leads to developing learner critical thinking capabilities.

Figure 1. Creating a budget XR OSCE environment in 2019

The MESH360 project (Figure 1) explored the key elements of how XR and high-fidelity mannikins might be used to design authentic learning experiences in paramedicine OSCE's through a mashup of virtual reality, an interactive room, high-fidelity mannikins for haptic feedback and biometric participant feedback. The MESH360 framework is detailed in Cochrane et al., (2020) and summarised here from Aguayo et al., (2021).

(1) Design environments that focus on combining XR design principles merging real environment elements with digital affordances (possibilities offered by digital tools and platforms) to provide a range of 'learning points' for different types of learners (i.e., from novice to experienced participants);
(2) focus on the embodiment of the experience to maximize the interactivity, authenticity, and realism of the enhanced immersive reality through a sequence of experiences including virtual and augmented reality (XR), enabling teamwork, high-fidelity simulation, and critical environmental soundscapes.

The MESH360 framework can be modified and used to design XR enhanced simulation in other healthcare and high-risk learning environments (Aguayo et al., 2021). As the framework is not focused on any technology it can also be extended with new dimensions and new technologies (Figure 2).

Figure 2. XR enhanced clinical practice 2023

This is timely as hospitals begin exploring the use of XR technologies such as the Apple Vision Pro for surgical logistics, real-time data access and visualisation that has previously been impossible (Armstrong et al., 2024; Lydon, 2024; Olexa et al., 2024). Healthcare graduates with XR enhanced simulation training will be better placed to meet these new practices "improving how healthcare is delivered to benefit all patients, whether it is through harnessing robotic or AI technology, or using the latest, evidence-based approaches to deliver care" (Lydon, 2024).

Developing Authentic XR Environments in 2024

In 2024 the University of Melbourne partnered with Simovation to install a Blended Learning Interactive Simulation Suite (BLISS https://simovation.com.au/immersive-technologies/). The project involves a collaborative transdisciplinary team of educational researchers, designers, practitioners, and industry professionals. The University of Melbourne leads the research and development team and includes medical education and educational technology. Industry Partners include: Simovation (Healthcare education Australasian BLISSuite supplier), Epworth Healthcare (Clinical Education and Simulation Centre) RealResponse BlueroomXR (Immersive reality simulation developers) and SeekBeak Canada (Web-based immersive reality platform). All Industry Partners are not-for-profit organisations or classified as small businesses/startups and therefore provide in-kind funding to support the project. The industry partners each provide expertise in each of the key design elements of the proposed XR enhanced simulation learning environment. Industry partner Simovation specialise in hardware and software for healthcare simulation, Epworth Healthcare Clinical Education and Simulation Centre will provide in-kind use of their simulation environment for implementing and evaluating the XR design framework on the learning outcomes of their trainees. SeekBeak provides a web-based XR development environment that is simple to use and can be implemented on a range of devices. We will utilise SeekBeak's expertise in supporting the development of interactive XR scenarios. The research team have a long-standing relationship with SeekBeak, having used their platform since 2016. Real Response has developed a custom-designed XR enhanced simulation training environment that will be used for testing the

XR enhanced design framework and potential commercialisation. Critical to the transferability of the MESH360 framework is the focus upon low-cost technological solutions that have low barriers to content creation and user training.

Initial Prototyping of BLISSuite Scenarios

Figure 3. BLISS demo of the MESH360 HeliVR scenario using SeekBeak

Room-based XR enhanced simulation scenarios (such as the BLISS low-cost virtual CAVE: Figure 3) support a collaborative environment with several students and instructors in the same space that can represent multiple real-life scenarios and be switched almost instantaneously. In addition to providing a limitless range of possibilities for physical scenarios, AR technology can overlay digital features to physical manikins to represent diversity within the virtual patients and work with real tools rather than controllers. Using Design Based Research (DBR), the project explores the impact of XR enhanced simulation on students' learning evaluated via pre/post experience surveys and focus groups, as well as observed structured clinical examinations (OSCEs). Student subjective feedback will be triangulated with scenario interaction data (eye-tracking and hot-spot activation heatmaps) and non-invasive biometric indicators (heart rate via smartwatch worn during the simulation experience) as an indicator of how realistically the enhanced simulation adds real world environmental stress within a safe learning environment. The development of a transferable framework for enhanced clinical simulation will build training staff digital literacies and innovative practice. These enhanced simulation learning environments will match real world practice, enabling critical thinking and facilitating learner agency resulting in graduates that are better prepared for problem solving in high-risk environments.

Conclusion

We have briefly explored the foundations of an on-going project to collaborate on the design of immersive reality enhanced simulation environments. Building upon the MESH360 framework the team is now working with industry partners (Simovation, Epworth Healthcare, RealResponse and Seekbeak) to prototype and evaluate XR environments in a variety of high-risk learning sceanrios that are a mashup of the BLISSuite interactive room space, Augmented Reality, High-Fidelity Manikins, and biometric feedback.

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