

ASCILITE 2025

Future-Focused:

Educating in an Era of Continuous Change

Beyond visual fidelity: The case for emotionally responsive immersive reality in healthcare simulation

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Healthcare training using simulation has experienced significant technological advancement, with immersive reality (XR) enhancements demonstrating impressive visual sophistication and procedural authenticity. However, this progress conceals a critical misalignment between technological priorities and educational outcomes. Current XR healthcare education operates under what we term the "fidelity fallacy" - the assumption that high visual realism automatically translates to effective clinical preparation (Hamstra et al., 2014). This presentation challenges this paradigm, arguing that the industry emphasis on environmental authenticity has systematically neglected the affective dimensions essential for clinical competence.

Contemporary research reveals that XR healthcare implementations predominantly focus on anatomical accuracy and procedural fidelity, while very few incorporate emotional regulation elements (Li, 2024). This disparity is particularly problematic given evidence that emotional resilience significantly impacts clinical performance and patient outcomes. Research consistently demonstrates that healthcare professionals and other stakeholders experiencing elevated stress show substantially decreased diagnostic accuracy and reduced communication effectiveness during critical incidents (Akhtar et al., 2025a). Yet existing XR systems present static, pre-programmed scenarios that fail to respond to learners emotional states, creating an authenticity gap between training and practice.

The disconnect becomes more pronounced when examining real-world clinical demands. Healthcare professionals face numerous unexpected variations during critical events, requiring constant emotional regulation and adaptive decision-making. Current XR implementations, despite their visual sophistication, cannot adapt to individual emotional responses, limiting their effectiveness in preparing learners for these complex realities. Whilst many simulation centres collect biometric data, very few utilise it for real-time adaptation, representing a significant underutilisation of available technology (Akhtar et al., 2025b).

This presentation advocates for a paradigm shift towards emotionally responsive XR systems that establish bidirectional relationships between learner and environment. Evidence from adjacent fields demonstrates the feasibility of such approaches - military training, aviation, and competitive sports have successfully integrated physiological monitoring with environmental adaptation (Yockey, 2023; Bernabei & Costantino, 2024). Healthcare education lag in adoption reflects not technological limitations but conceptual constraints rooted in the fidelity fallacy.

The argument extends beyond individual learning outcomes to systemic healthcare implications. Studies show simulations with real-time biofeedback yield substantial improvements in stress management, decision accuracy, and learning transfer compared to traditional approaches (Farsi et al., 2021). These improvements translate directly to patient safety and care quality. Furthermore, cultural considerations add complexity often ignored in current implementations - research identifies significant variations in stress manifestation and decision-making patterns amongst healthcare students from diverse backgrounds, yet few XR simulations incorporate culturally specific elements (Zhang et al., 2024).

The presentation introduces the Emotionally Responsive XR Clinical Environment (ERXCE) framework as a solution addressing these documented gaps. ERXCE establishes continuous feedback loops between physiological monitoring and adaptive scenario complexity, creating personalised learning experiences that prepare healthcare professionals for both technical and

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emotional challenges of clinical practice. By integrating affective computing with clinical simulation through multi-modal XR technologies, ERXCE addresses the critical gap between technical skill development and emotional resilience training.

This work argues for a shift in clinical simulation for healthcare training from static representation to responsive adaptation that recognises the complex interplay between technical competence and emotional regulation in healthcare practice.

Keywords: Healthcare simulation, XR technology, emotional resilience, biometric adaptation, clinical education, fidelity paradigm

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