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RETHINKING TECHNOLOGY-DRIVEN SIMULATION IN HEALTH EDUCATION: A QUALITATIVE EVALUATION OF LOW-FIDELITY APPROACHES

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Abstract

The growing adoption of high-fidelity, technology-centric simulations in health education has raised critical questions about their effectiveness, particularly when compared to low-fidelity methods. While high-fidelity simulations are often assumed to be superior due to their immersive capabilities, this study explores whether simpler, low-fidelity approaches may be equally or more effective in developing critical thinking and foundational clinical skills. This research aimed to (1) examine staff and student perceptions of low-fidelity simulation efficacy in skill development and critical thinking, (2) understand the experiential and reflective learning processes facilitated by low-fidelity approaches, and (3) explore perceived barriers and facilitators to using low-fidelity simulations in health education settings. Using a qualitative methodology, semi-structured interviews were conducted with 8 staff members and focus groups with 60 students across health care disciplines. Thematic analysis was applied to identify recurring themes and insights. Findings revealed that both staff and students valued low-fidelity simulations for their flexibility, accessibility, and ability to foster deep reflective learning without the distractions of advanced technology. Participants highlighted that low-fidelity simulations encourage active engagement and provide a psychologically safe environment for practising skills, allowing students to focus more on clinical reasoning than on managing complex equipment. Staff also noted that low-fidelity methods are easier to adapt to specific learning objectives, promoting a more tailored and responsive approach to skill acquisition. This study concludes that low-fidelity simulations hold significant, often overlooked potential for enhancing foundational learning in health education. By prioritising the learning experience over technological sophistication, educators may better address diverse learning needs, particularly in resource-constrained settings. These findings suggest the need to re-evaluate simulation design strategies, balancing both low and high-fidelity methods to optimise educational outcomes.

Keywords: *Simulation-based learning, low-fidelity simulation, experiential learning, health education, qualitative research.*

1. Introduction

Simulation-based learning has become a cornerstone of modern health education, offering opportunities for learners to practice clinical skills in controlled environments. While high-fidelity simulations (HFS) have dominated this space due to their ability to mimic real-life clinical scenarios with advanced technology, there is a growing interest in the potential benefits of low-fidelity simulations (LFS) (Coyne, Calleja, Forster, &Frances, 2021). This paper examines the efficacy of LFS in promoting critical thinking, skill acquisition, and reflective learning among health education students and staff, challenging assumptions about the necessity of high-fidelity tools in achieving educational outcomes (Gaba, 2007).

The focus on HFS often overlooks students' foundational learning needs and the resource constraints faced by many institutions (D'Souza, Venkatesaperumal, Chavez, Parahoo & Jacob, 2017). In contrast, LFS offers a more accessible, flexible, and cost-effective alternative that prioritises pedagogical value over technological complexity. By evaluating the perceptions and experiences of staff and students, this study aims to highlight LFS's overlooked advantages and contribute to a more balanced understanding of simulation-based learning.

2. Methodology

2.1. Research design

A qualitative research approach was employed to gain an in-depth understanding of staff and student experiences with simulations in health education. This approach aligns with the interpretive paradigm, emphasising participants' subjective interpretations of their lived experiences. The study was framed within a social constructivist perspective, enabling an exploration of how simulations across the healthcare disciplines studied, facilitate skill acquisition, critical thinking, and reflective learning (Creswell, 2017). This framework was deemed particularly suitable given the focus on the experiential dimensions of simulation and its influence on educational practices (Creswell, 2014; Saleem and Khan, 2023). Motivated by the increasing emphasis on simulation in health education and its capacity to address clinical skill shortages, this study investigated simulation practices within eight disciplines: nursing, physiotherapy, occupational therapy, diagnostic radiography, therapeutic radiography, oncology, dentistry, and orthoptics.

2.1.1. Participants. Two distinct participant groups were included in this study to capture a comprehensive range of perspectives:

- **Staff**: Eight staff members from the eight health care disciplines were purposively selected based on their involvement in developing and delivering simulation-based teaching. Their diverse levels of experience with LFS and HFS contributed to a rich dataset that included novice and seasoned educators.
- **Students**
  - **Focus Groups**: a total of forty-four undergraduate and postgraduate students enrolled in health educations programmes within the eight disciplines were recruited for participation. These students were organised into eight focus groups, ensuring representation across a range of disciplines and academic levels to facilitate the collections of diverse perspectives.
  - **Live Observations**: a total of eighty-six undergraduate and postgraduate students from health education programmes were observed during live simulation learning sessions. Observations were conducted once per subject discipline to capture the unique dynamics of each area.

Purposive sampling guided the selection of participants, ensuring representativeness and focusing on individuals directly engaged with LFS in their educational contexts.

2.1.2. Data Collection. Data collection employed a mixed-methods approach, incorporating semi-structured interviews, focus group discussions, and live observations of simulation sessions to provide a comprehensive understanding of participants' perceptions and experiences (Creswell, 2017). This triangulated approach enriched the dataset by capturing individual, collective, and contextual insights into the interactions between staff, students, and simulation environments (Cohen, Manion, & Morrison, 2011).

- **Semi-Structured Interviews:** Conducted with staff members, these interviews explored pedagogical strategies, perceptions of the effectiveness of live simulation (LFS), and challenges encountered during implementation. The semi-structured format provided flexibility for interviewers to probe emerging themes while ensuring consistency across participants.
- **Focus Group Discussions:** These discussions, conducted with student participants, fostered dynamic interactions and uncovered both shared experiences and divergent perspectives. Guided by open-ended questions, the discussions covered topics such as the perceived benefits of LFS, its role in reflective learning, and barriers to its effective use.
- **Live Observations of Simulation Sessions:** Observations were conducted with 86 undergraduate and postgraduate students from health education programmes during live simulation learning sessions. These sessions were observed once per subject discipline, enabling the capture of unique insights into the interactions between staff, students, and the simulation environment, including the dynamics that influence learning and teaching practices.

All interviews, focus groups, and observations were systematically documented, with audio recordings of interviews and discussions transcribed verbatim for analysis, ensuring the accuracy and reliability of the data collected.

2.1.3. Ethical Considerations. The institutional review board approved the study, ensuring compliance with ethical research practices. All participants gave informed consent, and they were assured of their anonymity and the confidentiality of their responses. They were also informed of their right to withdraw from the study at any point.

2.1.4. Data Analysis. Thematic analysis was employed to systematically examine the qualitative data, following Braun and Clarke's six-phase framework (Braun and Clarke, 2006):

1. **Familiarisation with the Data**: Transcripts were read and re-read to immerse researchers in the dataset and identify preliminary patterns.
2. **Initial Coding**: Transcripts were coded inductively, allowing themes to emerge organically from the data rather than being predetermined.
3. **Theme Development**: Codes were grouped into broader themes, reflecting key patterns and recurring insights.
4. **Reviewing Themes**: Themes were refined through iterative discussions among the researcher and participants to ensure coherence and relevance.
5. **Defining and Naming Themes**: Each theme was defined and named to encapsulate its essence succinctly.
6. **Producing the Report**: Themes were contextualised within the study's objectives and supported by illustrative quotes from participants.

To enhance the credibility and rigour of the analysis, several strategies were employed (Castleberry and Nolen, 2018):

- **Triangulation**: Insights from interviews and focus groups were cross validated to ensure consistency.
- **Peer Debriefing**: Preliminary findings were discussed with colleagues not directly involved in the study to gain external perspectives.
- **Participant Validation**: A subset of participants reviewed the themes to confirm their accuracy and resonance with lived experiences.

This robust methodological approach ensured that the findings were grounded in participants' authentic experiences and offered a comprehensive understanding of LFS in health education.

3. Findings

3.1. Perceived Benefits of Low-Fidelity Simulation

Flexibility and Accessibility

Participants consistently highlighted the adaptability of LFS to diverse learning environments, particularly in resource-constrained settings. Staff reported that LFS could be seamlessly integrated into classroom or community-based activities, enabling frequent and context-specific simulations. This adaptability made it possible to tailor simulations to meet specific learning objectives, such as conducting basic patient assessments or improving therapeutic communication. Students noted that the absence of complex technological requirements allowed them to focus more on learning outcomes and less on navigating unfamiliar equipment.

Reflective Learning and Critical Thinking

LFS was praised for its ability to foster reflective learning and critical thinking among students. Staff described how the simplicity of LFS created a distraction-free environment where learners could deeply engage with the task at hand. This focus on core skills, such as decision-making and clinical reasoning, was further reinforced by opportunities for debriefing and feedback. One staff member shared how role-playing exercises helped students grapple with ethical dilemmas and develop a patient-centred approach, while students emphasised that the iterative nature of LFS encouraged them to refine their problem-solving abilities.

Psychological Safety

Both staff and students valued the psychologically safe environment provided by LFS. Unlike high-fidelity setups, which can sometimes intimidate learners due to their technical complexity, LFS offered a low-pressure platform where mistakes were seen as part of the learning process. Students reported feeling more comfortable taking risks and experimenting with different approaches, which they saw as crucial for building confidence and competence. Staff echoed these sentiments, noting that the safe atmosphere of LFS fostered open dialogue and a willingness to learn from errors.

3.2. Challenges and barriers

Perceived Inferiority to High-Fidelity Simulation

Despite its benefits, some participants expressed concerns about the perceived lack of realism in LFS. Students with prior exposure to HFS noted that LFS did not replicate the immersive experience of advanced simulations, such as real-time physiological responses or lifelike patient interactions. Staff acknowledged these limitations but argued that LFS serves a complementary role, particularly in the foundational stages of learning. They emphasised that LFS should not be viewed as a substitute for HFS but rather as an equally important component of a holistic simulation-based curriculum.

Resource Allocation and Training

A recurring theme among staff was the challenge of securing institutional support for LFS. Many felt that the focus on high-fidelity technologies diverted resources and attention away from developing robust LFS programmes. Additionally, staff highlighted the need for professional development opportunities to enhance their skills in designing and facilitating LFS. Without adequate training and resources, they felt that the full potential of LFS could not be realised, limiting its impact on student learning**.**

4. Discussion

The findings of this study highlight the need to critically assess the balance between technological sophistication and pedagogical effectiveness in health education. High-fidelity simulations undoubtedly play a critical role in preparing students for complex, real-world scenarios. However, this study reveals that low-fidelity simulations, often relegated to a secondary status, offer unique advantages that are equally essential to holistic learning experiences.

A notable insight from this research is the capacity of LFS to foster deep reflective learning. The simplicity of these simulations encourages students to engage more actively with the content and focus on core learning objectives, such as clinical reasoning and foundational skills. Unlike HFS, which can sometimes overwhelm learners with its technical intricacies, LFS creates an environment where mistakes are less intimidating, thereby promoting iterative and meaningful learning experiences.

Low-fidelity simulations provide a flexible and adaptable learning platform that can cater to diverse educational contexts. For institutions facing financial and logistical constraints, LFS offers a pragmatic alternative that does not compromise educational quality. Moreover, the accessibility of LFS makes it an invaluable tool for widening participation in health education, ensuring that students from various socio-economic backgrounds have equitable access to high-quality training.

While LFS lacks the advanced realism of HFS, this study argues that perceived realism should not overshadow the broader pedagogical value of simulations. Realism is one aspect of effective learning, but it must be balanced with accessibility, adaptability, and the ability to meet diverse educational objectives. A comprehensive simulation strategy should integrate both high- and low-fidelity methods, leveraging their respective strengths to create an optimal learning environment.

The study also highlights systemic barriers to the wider adoption of LFS, including entrenched perceptions of inferiority and resource allocation challenges. Addressing these barriers requires institutional commitment to recognising the value of LFS, alongside investments in staff training and curriculum development. Staff development programmes that emphasise the pedagogical strengths of LFS can shift perceptions and build confidence in their use.

5. Conclusion

This study demonstrates that Low-fidelity simulations (LFS) are pivotal yet often underappreciated resources in health education. This study highlights their unique contributions to fostering critical thinking, reflective learning, and foundational skill acquisition. Unlike high-fidelity simulations, which can overshadow educational goals with technological complexity, LFS centres the learning experience, allowing students to focus on clinical reasoning and iterative skill refinement in a psychologically safe environment.

The findings underscore the need for a balanced integration of low- and high-fidelity simulations to optimise educational outcomes. LFS is particularly valuable in addressing the challenges of resource-limited settings, providing a cost-effective and adaptable alternative without compromising educational quality. However, systemic barriers, such as institutional biases and limited staff training, must be addressed to fully harness LFS's potential.

Future research should explore the longitudinal effects of LFS on clinical competence and their integration into broader curricular frameworks. By prioritising pedagogical value and accessibility, health education can better prepare students for the complexities of clinical practice while ensuring inclusive and equitable learning opportunities. This re-evaluation of simulation strategies offers a pathway toward more effective and holistic health education.

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