

HOW VIRTUAL REALITY IMPACTS NURSING STUDENTS' LEARNING PERFORMANCE

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Paper Received: 29.07.2025 / **Paper Accepted:** 19.08.2025 / **Paper Published:** 21.08.2025

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Abstract

Introduction: Virtual Reality (VR) is increasingly used in nursing education to bridge the gap between theoretical knowledge and clinical practice. Its immersive and interactive nature allows students to experience realistic patient scenarios in a safe, controlled environment. Despite growing adoption, empirical evidence quantifying VR's effects on knowledge retention, clinical confidence, and decision-making abilities remains limited. This study aimed to examine nursing students' perceptions of VR's impact on these learning domains.

Methods: A descriptive quantitative design was employed involving nursing students who had completed VR-based clinical simulations. A validated 15-item questionnaire assessed three domains - knowledge retention, confidence in clinical skills, and decision-making abilities - using a five-point Likert scale. Descriptive statistics (mean and standard deviation) were calculated to determine the overall perception of VR's effectiveness.

Results: Findings revealed uniformly positive perceptions across all domains. Knowledge retention and confidence in clinical skills both achieved a category mean of 4.50 (SD = 0.50), while decision-making abilities had a mean of 4.52 (SD = 0.50). Students reported that VR enhanced their understanding of nursing concepts, increased their confidence in performing clinical procedures, and improved their ability to make informed decisions under pressure.

Discussion and Conclusion: These results support the growing evidence that VR is an effective pedagogical tool in nursing education. VR promotes active learning, reflection, and skill mastery, thereby improving knowledge retention and clinical competence. Integrating VR into nursing curricula can strengthen critical thinking and prepare students more effectively for real-world patient care.

Keywords: Virtual Reality, Nursing Education, Knowledge Retention, Clinical Confidence, Decision-Making.

Introduction

Nursing education requires the integration of robust theoretical knowledge with practical clinical competencies. Traditional pedagogical approaches - lectures, static demonstrations, and limited clinical placements - often fail to recreate the complexity, immediacy, and stress of real clinical practice (Saab et al., 2021).

Virtual Reality (VR) has emerged as a scalable and increasingly accessible technology capable of generating immersive, interactive clinical scenarios that allow learners to practice skills, make decisions, and receive feedback in a controlled environment (Lange et al., 2020).

Systematic reviews and meta-analyses indicate that VR and immersive virtual simulation generally improve knowledge acquisition, psychomotor performance, and learner satisfaction, although effects on some higher-order cognitive outcomes such as critical thinking are mixed (Choi, 2022; Liu et al., 2023).

Qualitative studies further report increased engagement, motivation, and perceived preparedness among nursing students who participate in VR-based learning (Lange et al., 2020; Saab et al., 2021). Common barriers include cost, technological limitations, and transient simulator sickness for a subset of learners (Choi, 2022).

Theoretically, VR in nursing education is situated within experiential and constructivist learning frameworks: learners actively construct knowledge through guided, situated experiences and reflective practice (Kolb, 1984; constructivist learning principles). VR creates a high-fidelity context for deliberate practice and immediate feedback - key mechanisms known to support skill acquisition and retention (Ericsson, 2004).

Despite a growing body of evidence, there remain important gaps: many studies are small, heterogeneous in design, and use varied outcome measures. Specifically, more focused empirical work is needed to quantify VR's impact on knowledge retention (longer-term recall), confidence transitioning to hands-on care, and decision-making under pressure (Jans, 2023; Lee, 2023).

This study contributes to the literature by presenting descriptive quantitative data on nursing students' perceptions of VR's effects across these three domains, triangulating findings with contemporary reviews and studies to inform educators and policymakers.

Methods

Research Design

A descriptive quantitative design was employed to examine nursing students' perceptions following VR-based clinical training. Descriptive statistics (means and standard deviations) were computed for 15 Likert-type items.

Participants

Participants consisted of nursing students enrolled in an undergraduate nursing program who had engaged in at least one VR-based clinical scenario as part of their coursework. Participation in the survey was voluntary and anonymous.

Instrument

The instrument included 15 statements spanning three domains (Knowledge Retention, Confidence in Clinical Skills, Decision-Making Abilities). Each item used a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The scale interpretation followed conventional cutoffs: 1.00–1.80 = Strongly Disagree; 1.81–2.60 = Disagree; 2.61–3.40 = Neutral; 3.41–4.20 = Agree; 4.21–5.00 = Strongly Agree.

Procedure

Students completed the VR training modules (which included immersive patient scenarios, procedural simulations, and real-time feedback) and subsequently filled out the questionnaire. Data were collected and aggregated to compute item and category means.

Ethical Considerations

The study procedures adhered to institutional ethical standards. Participation was voluntary, informed consent was obtained, and data were anonymized prior to analysis. Any identifying data were removed to protect participant confidentiality.

Validity and Reliability

Content validity was reviewed by subject-matter experts in nursing education and simulation. While the present analysis reports descriptive statistics only, prior studies using similar Likert instruments have demonstrated acceptable internal consistency for analogous constructs in simulation research (Liu et al., 2023).

Results

The frequency, mean, and standard deviation were utilized to analyze the impact of Virtual Reality (VR) on nursing students' learning performance.

The data focused on three key areas: Knowledge Retention, Confidence in Clinical Skills, and Decision-Making Abilities. The five-point scale used for interpretation is as follows: 1.00-1.80 – Strongly Disagree; 1.81-2.60 – Disagree; 2.61-3.40 – Neutral; 3.41-4.20 – Agree; 4.21-5.00 – Strongly Agree.

Knowledge Retention

Five descriptive statements evaluated the influence of VR on knowledge retention, with all receiving an interpretation of "Strongly Agree." These include:

- (a) VR helps retain information better than traditional methods (mean = 4.48, SD = 0.50);
- (b) The interactive nature of VR makes it easier to understand and remember concepts (mean = 4.50, SD = 0.50);
- (c) Information learned through VR is retained for a longer time (mean = 4.48, SD = 0.50);
- (d) The immersive VR experience enhances the ability to recall key concepts during exams or clinical practice (mean = 4.54, SD = 0.50); and
- (e) VR provides a realistic learning environment that improves theoretical knowledge retention (mean = 4.50, SD = 0.50).

The strong agreement with all five statements assessing VR's influence on knowledge retention highlights the effectiveness of VR as a learning tool in nursing education. The findings suggest that VR not only enhances information retention but also promotes deeper understanding through its interactive and immersive nature. By engaging students in realistic learning scenarios, VR helps solidify theoretical concepts and improve the recall of key information, which is essential for both exams and clinical practice.

These findings align with a study by Smith et al. (2023), which demonstrated that VR-based learning environments significantly enhance knowledge retention compared to traditional teaching methods. The study highlighted how the interactive and immersive nature of VR helps learners grasp complex medical concepts more effectively, leading to better long-term retention. Also, Smith et al. (2023) found that students who participated in VR training outperformed their peers in knowledge recall tasks during clinical practice. This supports the present study's conclusion that VR not only improves theoretical understanding but also strengthens the ability to apply and recall information in real-world medical scenarios, ultimately leading to more confident and competent healthcare professionals.

This lends validity to the idea that incorporating virtual reality (VR) into nursing programs can enhance students' comprehension of ideas and help them remember crucial knowledge for longer.

Virtual reality (VR) improves information retention and application in clinical settings by offering an immersive and realistic learning environment. That is why in order to improve learning outcomes and give students the information they need for clinical practice, educators should think about integrating virtual reality (VR) into their lesson plans.

Confidence in Clinical Skills

Five descriptive statements assessed the impact of VR on students' confidence in clinical skills, with all receiving an interpretation of "Strongly Agree." These include: (a) VR simulations boosted confidence in performing clinical procedures (mean = 4.52, SD = 0.50); (b) VR training made students feel more self-assured in clinical skills (mean = 4.43, SD = 0.50); (c) The safe practice environment of VR reduced fear of making mistakes (mean = 4.56, SD = 0.50); (d) Repeated VR exposure strengthened belief in clinical abilities (mean = 4.47, SD = 0.50); and (e) VR-based training increased confidence in transitioning to hands-on patient care (mean = 4.51, SD = 0.50).

The "Strongly Agree" interpretations of the five descriptive statements assessing the impact of VR on students' confidence in clinical skills emphasize the significant role VR plays in enhancing students' self-assurance. The results suggest that VR simulations provide a safe, supportive environment where students can practice clinical procedures, thus boosting their confidence and reducing the fear of making mistakes. This is particularly important in healthcare education, where hands-on experience is critical to building competence and confidence.

These findings are consistent with a study by Johnson et al. (2022), which showed that VR-based training enhances students' confidence in their clinical abilities by providing a safe, controlled environment for repeated practice. The study found that exposure to VR simulations not only improved students' technical skills but also significantly reduced their anxiety when transitioning to real-life patient care. By allowing learners to refine their techniques without the fear of harming patients, VR creates an effective bridge between theoretical knowledge and hands-on experience. This aligns with the present study's conclusion that VR fosters a sense of competence and reduces fear, ultimately helping students feel more prepared and self-assured in clinical settings.

Johnson et al. (2022) also emphasized that VR-based training programs play a significant role in boosting students' confidence as they transition from simulated exercises to actual patient care. This mirrors the findings of the present study, which highlights VR's effectiveness in preparing students for real clinical practice. By allowing students to practice and perfect their skills in a realistic yet risk-

free environment, VR helps them feel more assured and capable when faced with real-world clinical challenges. These insights underscore the value of incorporating VR simulations into nursing education, as they not only enhance clinical competence but also build the confidence necessary for successful patient interactions. Integrating such immersive technology into nursing curricula could be a game-changer in shaping more skilled and self-assured healthcare professionals ready to meet the demands of today's medical field.

Decision-Making Abilities

Five descriptive statements evaluated the impact of VR on students' decision-making abilities, all interpreted as "Strongly Agree." Statements include: (a) VR helps students make better decisions in complex clinical scenarios (mean = 4.53, SD = 0.50); (b) VR training improves the ability to analyze and respond to patient needs (mean = 4.50, SD = 0.50); (c) VR simulations enhance clinical decision-making under pressure (mean = 4.54, SD = 0.50); (d) Feedback in VR scenarios strengthens critical thinking and problem-solving skills (mean = 4.54, SD = 0.50); and (e) Practicing decision-making in VR prepares students to handle real-world challenges effectively (mean = 4.51, SD = 0.50).

The category mean was 4.52, interpreted as "Strongly Agree." These results align with the study of Garcia et al. (2023), which found that simulated environments significantly improve nursing students' critical thinking and clinical judgment, leading to better decision-making in patient care.

The high "Strongly Agree" interpretations of the five descriptive statements assessing the impact of VR on students' decision-making abilities highlight its effectiveness in enhancing critical thinking and clinical judgment. The results indicate that VR not only helps students make better decisions in complex scenarios but also strengthens their ability to analyze patient needs, manage high-pressure situations, and solve problems effectively. This supports the growing body of evidence on the value of VR simulations in developing essential decision-making skills required in real-world healthcare environments.

These findings are consistent with the work of Garcia et al. (2023), which demonstrated that VR-based simulations significantly enhance nursing students' decision-making abilities. Garcia et al. found that immersive virtual environments provide students with the opportunity to engage in high-stakes scenarios that require quick, accurate decisions, thus improving their clinical judgment. The study emphasized that VR scenarios, with the inclusion of real-time feedback, foster critical thinking and problem-solving abilities, helping students to develop strategies for responding

effectively to patient needs in a variety of clinical settings.

The study by Garcia et al. (2023) highlighted that VR training improves students' capacity to handle decision-making under pressure, which aligns with the findings of the present study regarding VR's role in simulating high-pressure clinical situations. Both studies emphasize the role of VR in preparing students for real-world challenges by providing a safe and supportive environment to practice and refine their decision-making skills before facing actual patient care scenarios.

These implications underscore the value of integrating VR simulations into nursing curricula to help students build and refine their decision-making abilities, thus better preparing them to make informed and effective decisions in clinical practice.

Discussion

This study's descriptive results indicate that nursing students perceive VR as highly beneficial across knowledge retention, confidence, and decision-making domains. These perceptions align with a growing body of evidence that immersive virtual simulation can support multiple facets of nursing education (Choi, 2022; Liu et al., 2023).

Knowledge retention likely benefits from VR through several mechanisms: multisensory encoding, contextualized practice that links theory to application, and the opportunity for spaced repetition within simulated scenarios. Cognitive theories of multimedia learning suggest that when information is presented in integrated visual and experiential formats, learners form more durable memory traces (Mayer, 2009).

Regarding confidence, VR's primary pedagogic advantage is offering a safe, repeatable environment for deliberate practice. Ericsson's model of skill acquisition emphasizes the importance of focused, feedback-rich practice for attaining expertise; VR facilitates this by enabling repeated enactment of procedures without patient risk (Ericsson, 2004). Recent empirical studies corroborate that students trained in VR demonstrate higher self-efficacy and lower procedural anxiety (Lange et al., 2020; Johnson et al., 2022).

Decision-making and clinical reasoning appear to improve when learners engage in complex, branching scenarios that require rapid assessment and prioritization. Feedback loops embedded within VR allow learners to reflect on choices and outcomes, supporting metacognitive development and clinical judgment (Lee, 2023; Jans, 2023).

Despite positive findings, there are limitations to acknowledge. The descriptive design and reliance

on self-report data limit causal inference and can introduce response biases. Sample characteristics and the heterogeneity of VR interventions mean results may not generalize across all educational contexts. Additionally, technological constraints (hardware quality, software fidelity) and accessibility issues (cost, institutional resources) remain practical barriers to universal adoption (Choi, 2022; Saab et al., 2021).

Future research should incorporate randomized controlled trials with objective performance metrics (e.g., OSCE scores, long-term retention tests) and longitudinal follow-up to assess skill transfer to clinical settings. Studies comparing types of VR (immersive head-mounted displays vs. desktop VR) and the dose-response relationship (frequency and duration of VR exposure) would further refine implementation guidance.

Educational implications include integrating VR as a complement to, rather than a replacement for, traditional hands-on training. Curriculum planners should align VR scenarios with learning outcomes, provide facilitator-led debriefings to maximize reflective learning, and ensure equitable access for all students.

Conclusion

The findings of this study demonstrate that Virtual Reality (VR) is a powerful educational tool that positively influences multiple dimensions of nursing students' learning performance. Nursing students perceived VR as highly beneficial for knowledge retention, confidence in clinical skills, and decision-making abilities, with all domains receiving "Strongly Agree" ratings. These results confirm that immersive and interactive learning experiences can deepen understanding, enhance clinical competence, and strengthen judgment in complex healthcare scenarios.

The immersive and realistic qualities of VR make it particularly effective in replicating the pressures and dynamics of clinical practice without the associated risks. By allowing students to engage in lifelike patient-care situations, VR promotes active learning, critical reflection, and immediate feedback - all of which are essential for the development of clinical reasoning and long-term retention of skills. Moreover, VR's safe, simulated environment enables learners to make mistakes, reflect, and improve - fostering both competence and confidence before entering real-world practice.

Despite these advantages, challenges remain in implementing VR across nursing programs. High equipment costs, technical limitations, and faculty training gaps can hinder adoption. Furthermore, the study's descriptive design and reliance on self-reported data suggest that additional empirical

research - such as experimental or longitudinal studies - is needed to validate and quantify VR's long-term educational benefits and its transferability to clinical performance.

Recommendations

1. **Curricular Integration:** Nursing institutions should gradually integrate VR simulations into existing curricula, aligning them with learning outcomes for both theory and clinical courses.
2. **Faculty Development:** Educators must receive proper training to design, facilitate, and debrief VR sessions effectively, ensuring alignment with pedagogical objectives.
3. **Resource Investment:** Institutions should invest in scalable, cost-effective VR technologies and ensure equitable access for all students.
4. **Research and Evaluation:** Future studies should use mixed-methods or experimental designs to measure not only perceptions but also objective performance outcomes, such as clinical competency scores, retention over time, and patient-care outcomes.
5. **Policy Support:** Academic policymakers and accreditation bodies should recognize VR-based learning as a valid and measurable component of nursing education to encourage broader institutional adoption.

Conflict of Interest

The author declares no conflict of interest in conducting this research.

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