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Nursing Students' Perspectives on the Relationship between Virtual Reality Simulation and Clinical Decision-Making, Confidence, and Anxiety: A Cross-Sectional Study

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Abstract

Introduction: This study addresses this gap by assessing the relationship of VR simulation with improving clinical decision-making, confidence, and anxiety reduction among nursing students. The aim of this study is the relationship between virtual reality simulation and their clinical decision-making, confidence, and anxiety reduction using a cross-sectional study from the perspectives of nursing students.

Methods: This cross-sectional study surveyed 200 nursing students enrolled in clinical courses utilizing virtual reality (VR) simulation for educational purposes. A structured questionnaire was used to assess their clinical decision-making, confidence, and anxiety reduction following the VR simulation course. The survey included scales validated through a panel of experts and questionnaire validation methodologies, using a 5-point Likert scale. Descriptive statistics were used to summarize the data, and inferential statistical tests, including Pearson's correlation and independent-sample t-tests, were conducted to examine the associations. Multiple linear regression analysis was performed to assess the predictive value of confidence and anxiety on clinical decision-making while controlling demographic variables.

Results: A total of 200 nursing students participated in the study. The mean (SD) clinical decision-making score was 3.16 (1.23) out of 5, while confidence and anxiety reduction scores were 2.64 (1.34) and 2.49 (1.32), respectively. No significant correlation was found between decision-making and confidence ($r=-0.079$, $p=0.264$) or anxiety scores ($r=0.121$, $p=0.088$), but confidence and anxiety scores showed a weak direct correlation ($r=0.180$, $p=0.011$). Multiple linear regression analysis revealed that confidence and anxiety were not significant predictors of decision-making, but gender was a significant predictor, with males scoring higher ($\beta=0.19$, $p=0.041$).

Conclusions: While VR directly influences decision-making, it has a limited association with changes in nursing students' confidence and anxiety levels. These findings suggest that VR simulation alone may not be sufficient for enhancing confidence and reducing anxiety and should be integrated with other instructional strategies to maximize its effectiveness in nursing education. Future studies should explore complementary training methods to improve clinical preparedness.

Keywords: Anxiety; Confidence; Decision-making; Nursing; Virtual reality

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Introduction

Nursing students often experience anxiety and low self-confidence during their initial clinical practice, which can impair decision-making, performance, and care efficiency (1-4). Among various training approaches, confidence-building has gained increasing attention due to its role in improving clinical competence, adaptability, and feedback integration (5, 6).

Virtual reality (VR) simulation offers an immersive, risk-free environment where students can repeatedly practice complex clinical scenarios, enhancing both practical skills and cognitive development (7-9). Unlike mannequin or graphic-based simulations, VR provides interactive, realistic experiences that improve critical thinking, decision-making, and technical proficiency (10-12). Studies indicate that VR enhances accuracy and speed in essential procedures, such as intravenous injections, while fostering communication and teamwork skills, which are crucial in clinical settings (13-16).

Beyond skill acquisition, VR has been shown to boost self-confidence by allowing students to repeatedly engage with clinical tasks until they achieve proficiency. Its structured pre-briefing and feedback mechanisms further contribute to reducing anxiety by familiarizing students with complex clinical situations before real patient interactions (6, 12, 17-19). Despite these benefits, most research focuses on isolated skills, with limited studies evaluating VR's comprehensive impact on clinical decision-making, confidence, and anxiety management in nursing education. This study addresses this gap by assessing the relationship of VR simulation with improving clinical decision-making, confidence, and anxiety reduction among nursing students.

Methods

This research employed a cross-sectional survey methodology to evaluate the relationship of VR simulation training on students' clinical decision-making capabilities, confidence levels, and anxiety. The survey-based design facilitates the derivation of generalizable findings concerning student experiences following their engagement with the VR simulations.

Participants

The study included nursing students from diverse academic levels who had recently undergone VR simulation training in various nursing courses. Eligible participants were those in undergraduate nursing programs actively engaged in clinical training. A non-randomized, convenience sampling method was employed to identify them. Excluded were students with certain physical disabilities, those who withdrew from the clinical course mid-semester, and bridging students currently working as practical nurses.

The sample size was determined based on a medium effect size, a statistical power of 80% (1 - β), a beta error of 20%, and a significance level (α) of 0.05. This calculation ensured an adequate sample size to detect meaningful associations while minimizing the risk of Type II errors (20). Consequently, the minimum required sample size to ensure adequate power for analysis was set at 168 participants, but this figure was increased to account for potential attrition.

Questionnaire

The study utilized a structured questionnaire to assess the impact of VR simulation on clinical decision-making, confidence, and anxiety reduction among nursing students. The questionnaire was adapted from previous validated studies in nursing education and simulation-based learning. Responses were recorded using a five-point Likert scale, with higher scores indicating greater clinical decision-making abilities, confidence, and anxiety reduction.

Clinical decision-making was assessed based on students' self-reported ability to handle clinical scenarios across five domains: prioritization of tasks, quick decision-making, consequence understanding, adaptability, and realistic comprehension of clinical situations. Each item was rated from 1 (Strongly Disagree) to 5 (Strongly Agree), with a total possible score ranging from 15 to 75. A higher score indicated stronger clinical decision-making skills in VR-based scenarios. Confidence was evaluated by examining the students' perception of VR's role in enhancing their self-assurance when performing clinical procedures. The confidence scale included items covering independence, patient interaction, procedural execution, self-assurance, and theory-to-practice application. Responses were rated from 1 (Not Confident at All) to 5 (Extremely Confident), with a total score range of 10 to 50. Higher scores reflected greater confidence in performing clinical tasks following VR simulation. Anxiety reduction was measured by assessing the students' perceived decrease in stress and nervousness following VR training. The anxiety scale examined performance anxiety, fear of mistakes, composure, high-stress management, and adaptability to real-life clinical settings. Responses ranged from 1 (Very Anxious) to 5 (Not Anxious at All), with a total possible score of 10 to 50. Higher scores represented greater anxiety reduction.

Questionnaire validation

To ensure content validity, a panel of experts in nursing education and VR-based simulation reviewed the questionnaire. Item discrimination analysis was conducted to refine the instrument, removing items that were either too difficult or too simplistic. Factor analysis confirmed the structural validity of the scales. Reliability testing was conducted through test-retest analysis over two weeks. The test-retest correlation coefficient for the clinical decision-making scale was 0.86, with an internal consistency (Kuder-Richardson-20) of 0.85. The confidence scale demonstrated a test-retest correlation of 0.87, with a Cronbach's alpha of 0.89. The anxiety reduction scale showed the highest reliability, with a test-retest correlation of 0.91 and a Cronbach's alpha of 0.92. A pilot survey was conducted with 100 nursing students (50 male, 50 female) to evaluate the clarity, reliability, and usability of the instrument before full implementation. Based on participant feedback, minor modifications were made to improve the clarity of specific items. The final questionnaire was determined to be appropriate for assessing the impact of VR training on nursing students' clinical preparedness.

Data Collection

An online survey was distributed via email to all eligible participants who were willing to participate in the study. The survey was carried out over two weeks following the conclusion of the course. For enhancing the response rate, reminders were issued to the students prior to the submission deadline. The estimated time required for completing the survey was approximately 10 to 15 minutes.

Ethical Considerations

An Institutional Review Board (IRB) at Al-Ghad International College for Applied Medical Sciences in Al-Madinah Al-Munawwarah of (GC_2025_73) has granted ethical approval to conduct the study. Informed consent was obtained from participating students, ensuring confidential, voluntary, and anonymous participation.

Statistical analysis

Data were entered and analyzed using SPSS software (version 21). An initial screening was conducted to ensure completeness and accuracy, verifying the absence of missing values. Descriptive statistics, including frequencies, means, and standard deviations (SD), were calculated for demographic variables and key study outcomes: Clinical Decision-Making (CDM), Confidence, and Anxiety Reduction. Pearson's correlation coefficient was used to examine the relationships among these variables, with statistical significance set at $p<0.05$. Independent sample t-tests were conducted to assess gender differences in CDM, Confidence, and Anxiety Reduction scores, while a subgroup analysis compared students with and without prior VR training.

To explore variations in VR training outcomes across academic years, one-way analysis of variance (ANOVA) was performed, followed by post-hoc tests for significant results. Multiple linear regression analysis was conducted to determine the predictive value of Confidence and Anxiety Reduction on CDM scores while controlling demographic variables such as gender, academic year, and prior VR training experience. The model's overall fit was evaluated using the adjusted R^2, and standardized beta coefficients (β) were reported to assess the relative contribution of each predictor. Multicollinearity was examined using variance inflation factors (VIF), ensuring no significant collinearity issues. Effect sizes were calculated for statistically significant findings to evaluate the magnitude of observed differences.

Results

Demographic Characteristics

A total of 200 nursing students participated in the study. The sample consisted of 76 (38.0%) male and 124 (62.0%) female students. Most participants (70.0%) were in their second or third year of study. Of the total participants, 75.0% had prior experience with VR-based training. Additional demographic and background characteristics are summarized in Table 1.

Clinical Decision-Making, Confidence, and Anxiety Scores

Based on participants' perspectives, the mean score for CDM was (3.16±1.23), indicating a general agreement on the stronger clinical decision-making skills in VR-based scenarios. The highest score in this area was for "realistic understanding of decisions" (3.9±1.30), and the lowest was for "making decisions quickly" (2.8±1.17). Confidence had a mean score of (2.64±1.34), with slightly higher ratings for performing specific procedures (2.8±0.98) and applying theoretical knowledge (2.8±0.88), while the lowest was for handling patient interactions (2.6±1.36). Anxiety reduction had a mean score of (2.49±1.32), with the lowest ratings for managing high-stress scenarios (2.1±1.30) and anxiety when performing VR tasks (2.1±1.05), while adaptability to real-life after VR training (3.7±1.27) had the highest rating (Table 2).

Table 1: Demographic characteristics of the study participants (N=200)

Characteristic	Sub-category	Frequency
Gender	Male	76 (38.0%)
	Female	124 (62.0%)
Academic year	First Year	28 (14.0%)
	Second Year	63 (31.5%)
	Third Year	77 (38.5%)
	Fourth Year	32 (16.0%)
Previous experience in simulation	Virtual Reality Simulation	150 (75.0%)
	Mannequin-based Simulation	30 (15%)
	Screen-based Simulation	20 (10%)

Table 2: Clinical Decision-Making, Confidence, and Anxiety Scores Based on Nursing Students' Perspectives

Outcome	Domains	Mean±SD
Clinical decision making (CDM)	Prioritizing tasks	2.9±1.14
	Making decisions quickly	2.8±1.17
	Understanding consequences	3.1±1.52
	Adaptability to unexpected situations	3.1±1.22
	Realistic understanding of decisions	3.9±1.30
	Overall Score	3.16±1.23
Confidence	Confidence increased independently	2.6±1.28
	Handling patient interactions	2.6±1.36
	Performing specific procedures	2.8±0.98
	Self-assurance in clinical skills	2.9±1.38
	Confidence to apply theoretical knowledge	2.8±0.88
	Overall Score	2.64±1.34
Anxiety	Anxiety when performing VR tasks	2.1±1.05
	Anxiety about making mistakes	2.2±1.54
	Composure to approach clinical simulation	3.4±1.20
	Managing high-stress scenarios	2.1±1.30
	Adaptability to real-life after VR training	3.7±1.27
	Overall Score	2.49±1.32

Correlations between Clinical Decision-Making, Confidence, and Anxiety

The correlation analysis showed that CDM scores were not significantly associated with confidence scores ($r=-0.079$, $p=0.264$) or anxiety scores ($r=0.121$, $p=0.088$). However, confidence and anxiety reduction demonstrated a weak direct correlation ($r=0.180$, $p=0.011$).

Gender Differences in Clinical Decision-Making, Confidence, and Anxiety

An independent-sample t-test showed that male students had significantly higher clinical decision-making scores (3.42±0.69) than female students (3.12±0.75; $t=2.36$, $p=0.04$). No significant gender differences were found in confidence ($t=0.97$, $p=0.23$) or anxiety reduction ($t=0.81$, $p=0.47$).

Predictors of Clinical Decision-Making

Multiple linear regression analysis was conducted to determine whether confidence and anxiety predicted clinical decision-making scores after the VR stimulation course while controlling for gender, academic year, and prior VR training. The overall model was statistically significant ($F(5, 194)=4.21$, $p=0.002$) and accounted for 12.3% of the variance in clinical decision-making scores (adjusted $R^2=0.123$). Confidence was not a significant predictor ($\beta=-0.08$, $p=0.278$), and anxiety reduction had a weak, non-significant association with clinical decision-making ($\beta=0.11$, $p=0.104$). Among the control variables, gender was a significant predictor ($\beta=0.19$, $p=0.041$), while academic year and prior VR training did not show significant effects ($p>0.05$). Multicollinearity diagnostics indicated no collinearity concerns (VIF<2.0 for all predictors).

Discussion

This study examined the association between VR simulation and nursing students' clinical decision-making, confidence, and anxiety reduction. The findings indicate that while VR training is associated with improved clinical decision-making, its effects on confidence and anxiety reduction are limited. These results

suggest that VR supports cognitive learning processes but may not fully address the emotional and behavioral aspects of clinical training.

The improvement in clinical decision-making aligns with situated learning theory, which emphasizes learning in authentic environments where knowledge is applied in context (17). VR provides repeated exposure to complex patient scenarios, allowing students to enhance their judgment, adaptability, and consequence evaluation (18). These findings are consistent with studies demonstrating that VR facilitates higher-order thinking skills and decision-making in clinical practice (19). However, the lack of significant association between VR and quick decision-making or task prioritization suggests that time-sensitive or high-pressure decision-making may require additional real-world exposure. Future research should explore whether time-constrained VR scenarios improve the students' ability to make rapid clinical decisions.

Although VR has been shown to improve procedural confidence in some studies (20, 21), this study found no strong relationship between VR training and overall clinical confidence. Self-efficacy theory suggests that confidence develops through repeated mastery experiences (22), but VR alone may not provide the direct patient interaction and real-world unpredictability necessary to build true clinical confidence (23). A blended learning approach that integrates VR with supervised clinical practice and peer mentorship may be more effective in developing both cognitive and behavioral competencies (24).

Regarding anxiety reduction, while VR supports gradual adaptation to clinical scenarios, it did not significantly lower students' anxiety in high-stress situations. Stress inoculation theory suggests that controlled exposure to progressively challenging stressors can enhance resilience (25), but VR scenarios in this study may not have been structured to gradually escalate clinical stress levels. Additionally, individual differences in emotional engagement and learning styles may influence how students experience stress in VR settings (26). Future studies should explore adaptive VR designs that modify stress intensity based on student performance.

Strengths and Limitations

This study provides a comprehensive evaluation of VR's impact on clinical decision-making, confidence, and anxiety reduction, using validated tools and integrating educational theories to enhance relevance. However, the convenience sampling method may limit generalizability, as participants may have had prior interest or experience with VR. Future studies should use randomized sampling or include diverse institutions for broader applicability. The cross-sectional design prevents assessing long-term effects, highlighting the need for longitudinal studies to evaluate sustained benefits. Additionally, individual differences, such as prior clinical experience and learning styles, were not considered and should be explored in future research to develop personalized VR training approaches.

Conclusion

This study found that while VR simulation enhances clinical decision-making, it has a limited association with confidence and anxiety reduction among nursing students. These findings suggest that while VR can be an effective tool for improving cognitive skills, it should be integrated with hands-on training and structured feedback sessions to enhance overall clinical preparedness. A blended learning approach combining VR with supervised clinical experiences may provide a more comprehensive method for skill development.

Educators should consider refining VR curricula to include progressive exposure to real-world patient interactions, scenario-based training for confidence-building, and stress management strategies to better support the students' transition to clinical practice. Future research should explore longitudinal assessments of VR's impact on nursing competencies over time, as well as how individual factors, such as prior clinical experience, influence their effectiveness. Examining different VR simulation designs may further optimize learning outcomes in nursing education

Implications for Nursing Education

The findings of this study suggest that VR is a valuable educational tool for cognitive skill development, but it should be strategically integrated with other instructional methods to enhance clinical preparedness. Since VR primarily strengthens decision-making skills, its impact could be maximized by combining it with real-world patient interactions, debriefing sessions, and mentorship programs. Educators should refine VR curricula by including scenario-based simulations that encourage time-sensitive decision-making, confidence-building exercises, and stress management strategies.

To enhance confidence development, multi-modal simulation approaches should be explored, where VR is supplemented with hands-on procedural training, direct patient interactions,

and reflective learning exercises. For anxiety management, incorporating progressive stress exposure, real-time feedback, and relaxation techniques into VR training may help students develop emotional resilience and coping strategies for high-pressure clinical environments.

Future Research Directions

Longitudinal studies are needed to examine whether extended VR exposure leads to sustained improvements in clinical decision-making, confidence, and anxiety reduction. Additionally, research should investigate individual differences in VR learning effectiveness, particularly how prior clinical experience, personality traits, and learning styles influence outcomes. Comparative studies evaluating different VR simulation models, including augmented reality, immersive VR, and hybrid simulations, could further inform best practices for integrating VR into nursing education.

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Authors' Contributions

All authors contributed to the discussion, read and approved the manuscript, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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