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Efficacy of a Novel Simulation-Based Instructional Model in Enhancing Emergency Nursing Competence Among Nursing Students

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Abstract

Emergency nursing education faces persistent challenges in bridging the theory-practice gap, particularly in preparing nursing students for high-stakes clinical situations. Although simulation-based education shows promise, there remains a critical need for evidence-based, comprehensive instructional models that can effectively cultivate and sustain emergency nursing competence. This quasi-experimental study pursued three primary objectives: (1) to develop and validate a novel simulation-based instructional model for emergency nursing education, (2) to evaluate the longitudinal impact of the model on knowledge and skills acquisition at 4, 8, and 12 weeks post-intervention, and (3) to examine the relationship between theoretical understanding and clinical performance throughout the intervention period. Using a one-group pretest-posttest design, 30 fourth-year nursing students at Boromarajonani College of Nursing, Uttaradit, participated in a 12-week intervention. The study employed multiple validated instruments including, (1) a 50-item emergency nursing knowledge assessment (Content Validity Index = 0.87, Cronbach's alpha = 0.85), (2) a structured clinical performance evaluation checklist (Inter-rater reliability ICC = 0.92), and (3) a standardized debriefing tool based on the Promoting Excellence And Reflective Learning in Simulation (PEARLS) framework. The instructional model, grounded in Kolb's (1984) Experiential Learning Theory and Jeffries, Rodgers, and Adamson's (2015) Simulation Framework, comprised three phases: preparation, implementation, and evaluation. An analysis of variance (ANOVA) for repeated measures revealed significant improvements in both knowledge ($F(2.14, 62.06) = 1471.929$, $p < .001$, partial $\eta^2 = .981$) and skills ($F(2.32, 67.28) = 970.392$, $p < .001$, partial $\eta^2 = .971$) across all time points. Post-hoc analyses indicated sustained learning gains, with the most substantial improvements occurring between baseline and week 4. Correlation analysis indicated a strong positive relationship between knowledge and skills scores ($r = 0.72$-0.85, $p < .001$). These findings suggest that the developed simulation-based model significantly enhances and maintains emergency nursing competence, offering a promising instructional approach for nursing education. Future research should investigate long-term retention and the transferability of acquired competencies to clinical practice.

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Introduction

Emergency nursing is among the most demanding fields in healthcare, where rapid assessment and timely intervention are critical to patient survival and outcomes. The growing complexity of emergency care—driven by rising patient acuity and advancing medical technologies—requires nursing graduates to possess robust theoretical knowledge and well-developed clinical skills (Mulyadi, Tonapa, Rompas, Wang, & Lee, 2021; Oh & Jung, 2024). However, traditional educational methods fall short in providing sufficient hands-on experience in high-pressure scenarios, contributing to a persistent theory-practice gap that may compromise the quality and safety of patient care (Nair, Muthu, & Abuijlan, 2024). Simulation-based education has become an essential pedagogical approach in emergency nursing education, offering distinct advantages over traditional methods. It provides a controlled, risk-free environment where students can practice high-stakes procedures without compromising patient safety. Given the unpredictable and infrequent nature of emergency scenarios in clinical placements, simulation ensures consistent exposure to critical cases for all learners. Moreover, it facilitates immediate feedback and structured reflection—key learning processes often unattainable during real-time emergencies (Alharbi, Almarzuqi, Alghamdi, Alanazi, & Alharbi, 2024; Tong et al., 2024). Importantly, it supports the integrated development of both technical and non-technical skills, including clinical decision-making, team communication, leadership, and crisis resource management (Curtis, Munroe, Van, & Elphick, 2020; Hamdi & Al Thobaity, 2023).

Emergency nursing competence encompasses two fundamental domains that must be developed systematically: knowledge competencies and clinical skills competencies. Knowledge competencies include: (1) advanced pathophysiology of acute and life-threatening conditions, (2) emergency pharmacology and medication management protocols, (3) evidence-based triage principles and decision-making frameworks, (4) current emergency care guidelines and algorithms, and (5) legal and ethical considerations in emergency care delivery. Clinical Skills Competencies involve: (1) rapid patient assessment and vital signs interpretation, (2) advanced life support interventions and procedures, (3) emergency medication administration and monitoring, (4) critical care procedures and equipment management, (5) team coordination and crisis communication, and (6) resource management during emergency situations (Jang, Kim, & Kim, 2020; Wang et al., 2024). Despite the increasing use of simulation in nursing education, several critical gaps persist in the current literature. First, most studies have concentrated on isolated simulation scenarios rather than comprehensive instructional models that can be systematically integrated into nursing curricula (Park, Shin, Kwak, & Lee, 2024). Second, research on the long-term retention of knowledge and skills gained through simulation-based education remains limited (Kiegaldie & Shaw, 2023). Third, few investigations have specifically addressed the role of simulation in developing and sustaining emergency nursing competence (Jung & Roh, 2022).

The urgency of addressing these gaps has been further underscored by recent global health challenges. The COVID-19 pandemic has revealed the critical need for nurses capable of responding effectively to rapidly evolving clinical crises, reinforcing the importance of robust emergency nursing education (Ozata & Dinc, 2025). Additionally, the World Health Organization (2020) has identified emergency care capacity building as a global healthcare priority, emphasizing the need for evidence-based educational strategies that adequately prepare nurses for emergency care roles. This study aims to respond to these challenges by evaluating the efficacy of a comprehensive simulation-based instructional model in developing and sustaining emergency nursing competence. By examining both immediate and longitudinal learning outcomes, this research seeks to generate meaningful insights into the effectiveness of structured simulation-based education in equipping nursing students for the complex demands of emergency care practice.

Objectives

Emergency nursing education faces unique challenges in preparing competent graduates for complex, high-stakes clinical environments (Mulyadi et al., 2021; Nair et al., 2024). Although simulation-based learning has demonstrated potential in bridging the theory-practice gap, there remains a need for evidence-based evaluations of comprehensive instructional models that can effectively develop and sustain emergency nursing competence. This study was designed to address these gaps through the following objectives:

1. To evaluate the efficacy of a simulation-based instructional model in enhancing emergency nursing competence among fourth year nursing students, including: (1) assessment of knowledge acquisition in emergency

care principles, (2) evaluation of clinical skills development, and (3) measurement of team performance and crisis management abilities.

2. To assess the longitudinal impact of the simulation-based model on emergency nursing knowledge and skills acquisition at 4, 8, and 12-weeks post-intervention assessments, including: (1) tracking knowledge retention across time points, (2) monitoring skills maintenance and improvement, and (3) evaluating sustained learning outcomes.

3. To analyze the relationship between theoretical knowledge acquisition and clinical skills performance throughout the intervention period, including: (1) examining correlations between knowledge and performance, (2) identifying predictors of competence development, and (3) assessing the integration of theory and practice.

These objectives align with current educational priorities in emergency nursing and address key gaps identified in simulation-based education research (Park et al., 2024; Alharbi et al., 2024). The emphasis on longitudinal assessment and the interplay between knowledge and skills offers valuable insights for curriculum design and instructional practice.

Literature review

Emergency nursing education faces persistent challenges in preparing competent graduates for increasingly complex healthcare environments. Contemporary research highlights a troubling gap between theoretical knowledge and practical skills among newly graduated nursing entering emergency care settings. This disparity becomes especially critical in high-stakes emergency situations, where timely and accurate clinical decisions directly affect patient outcomes (Mulyadi et al., 2021).

Simulation-based education has emerged as a transformative pedagogical approach, particularly in emergency nursing education. A systematic review by Nair et al. (2024) demonstrated that high-fidelity simulation outperforms traditional clinical education in enhancing nursing students' knowledge acquisition and skill development. These findings have contributed to a paradigm shift in nursing education, encouraging educators to critically reevaluate conventional teaching methodologies. Additionally, Alharbi et al. (2024) reported significant improvements in emergency care competence among students who have received simulation-based training compared to traditional approaches.

The theoretical foundations of simulation-based education in nursing are anchored in two primary frameworks: Kolb's Experiential Learning Theory and Jeffries' Simulation Framework. Together, these complementary perspectives provide a comprehensive lens for understanding how simulation enhances learning in clinical education:

Application of Kolb's Experiential Learning Theory in Emergency Nursing:

1. Concrete Experience: Students engage directly in realistic emergency scenarios, simulating high-stakes clinical environments.

2. Reflective Observation: Structured debriefing sessions encourage critical reflection on actions, decisions, and outcomes.

3. Abstract Conceptualization: Learners synthesize theoretical knowledge with practical experience to form deeper clinical understanding.

4. Active Experimentation: Students apply refined insights to new emergency situations, reinforcing adaptive decision-making and skill transfer.

Jeffries et al.'s (2015) Simulation Framework provides a structured foundation for simulation-based education through five key components:

1. Teacher factors: Facilitator expertise and preparation

2. Student factors: Learner engagement and self-direction

3. Educational practices: Active learning strategies and timely feedback

4. Design characteristics: Clearly defined objectives and simulation fidelity

5. Outcomes: Improvements in knowledge, clinical skills, and learner satisfaction

Recent meta-analyses offer compelling evidence for the effectiveness of simulation in nursing education. Mulyadi et al. (2021) conducted a comprehensive analysis demonstrating significant gains in both cognitive and psychomotor domains among nursing students exposed to simulation-based instruction, with effect sizes ranging from moderate to large. Building on this, Tong et al. (2024) reported superior clinical decision-making skills in students who participated in high-fidelity emergency simulations, based on findings from a randomized controlled trial.

The International Nursing Association for Clinical Simulation and Learning (INACSL) Standards Committee (2016) has established best practices for simulation design and implementation, emphasizing the importance of clear learning objectives, facilitator preparation, appropriate fidelity levels, and structured debriefing methods. Despite these guidelines, several gaps persist in current research: (1) limited investigation of comprehensive instructional models, (2) insufficient data on long-term knowledge and skill retention, (3) lack of standardized assessment tools, and (4) a need for cost-effectiveness analysis in various educational settings. Park et al. (2024) highlighted the importance of economic evaluation in simulation-based education, particularly in resource-constrained environments. This perspective is increasingly relevant as nursing programs worldwide seek to adopt high-fidelity simulation technologies. The COVID-19 pandemic has further amplified the urgency of effective simulation-based education. Ozata and Dinc (2025) reported heightened demands for nurses proficient in emergency care, reinforcing the need for robust educational methodologies capable of preparing students for complex clinical situations.

This literature review indicates that while simulation-based education demonstrates strong potential in emergency nursing education, critical gaps remain. These include the need for comprehensive instructional models, longitudinal effectiveness studies, standardized assessment tools, and cost-benefit analyses. Addressing these gaps informs the basis for investigating the efficacy of a structured simulation-based instructional model in enhancing emergency nursing competence among nursing students.

Conceptual framework

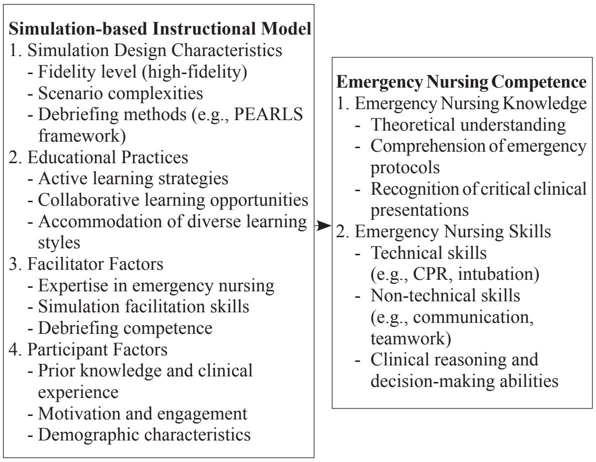

Figure 1 Conceptual framework

The conceptual framework guiding this study integrates foundational principles from Kolb's Experiential Learning Theory (Kolb, 1984) and Jeffries' Simulation Framework (Jeffries et al., 2015), alongside contemporary emergency nursing competencies (World Health Organization, 2020). This integrated framework illustrates the dynamic relationship between the instructional intervention, experiential learning processes, and measured outcomes relevant to emergency nursing education.

Independent Variable: Simulation-based Instructional Model

1. Educational Design Elements:

a. Simulation scenarios are developed based on evidence-based emergency care protocols (Mulyadi et al., 2021).

b. Complexity levels progress in alignment with defined learning objectives (Park et al., 2024).

c. The PEARLS debriefing framework is implemented to facilitate structured reflection and learner transfer:

Phase 1: Reactions and emotions processing

Phase 2: Description and simulation event analysis

Phase 3: Critical analysis of actions and decisions

Phase 4: Application of insights to future clinical scenarios

2. Learning Process Components:

Kolb's (1984) Experiential Learning Cycle is integrated with the model to guide student engagement and reflection:

Concrete Experience: Active participation in simulation scenarios

Reflective Observation: Engagement in structured debriefing sessions

Abstract Conceptualization: Connecting practical experience to theoretical frameworks

Active Experimentation: Applying refined understanding to subsequent clinical tasks

Dependent Variables: Emergency Nursing Competence

1. Knowledge Domain (Nair et al., 2024): a. Emergency care principles b. Clinical decision-making frameworks c. Protocol application d. Risk assessment e. Resource management

2. Skills Domain (Jung & Roh, 2022): a. Technical skills:-Emergency procedures-Equipment handling-Intervention timing b. Non-technical skills:-Team communication - Leadership - Crisis management

Mediating Variables

1. Learning Environment Factors (Jeffries et al., 2015): a. Psychological safety b. Facilitator expertise c. Equipment fidelity d. Group dynamics

2. Individual Characteristics (Mulyadi et al., 2021): a. Prior clinical exposure b. Academic performance c. Learning style preferences d. Motivation levels

Hypothesized Relationships

This study proposes a set of hypotheses to examine the direct and mediating effects of simulation-based instructional design on emergency nursing competence.

1. Direct Effects: a. H1: Increased exposure to simulation-based instruction positively influences both knowledge acquisition and skills development (Tong et al., 2024). b. H2: Progressive scenario complexity enhances clinical decision-making capabilities among nursing students (Alharbi et al., 2024).

2. Mediating Effects: a. H3: Learning environment factors moderate the effectiveness of simulation-based education (Kiegaldie & Shaw, 2023). b. H4: Individual learner characteristics mediate learning outcomes (Wang et al., 2024).

The framework posits that emergency nursing competence develops through structured experiential learning cycles, facilitated by simulation-based instruction. This developmental process is moderated by both environmental and individual factors and is evaluated using validated assessment tools administered at designated intervals (Hosseini et al., 2023).

Variable Measurement

1. Independent Variables: a. Implementation of fidelity checklists b. Facilitator evaluation forms c. Student engagement metrics

2. Dependent Variables: a. Knowledge assessment scores b. Skills performance evaluations c. Competency progression tracking

3. Mediating Variables: a. Environmental assessment tools b. Individual characteristic surveys c. Learning style inventories

Research methodology

Research design

This quasi-experimental study employed a one-group pretest-posttest design with repeated measures at baseline, 4, 8, and 12 weeks. The design was selected to facilitate longitudinal assessment of the progressive development of emergency nursing competence (Tong et al., 2024). While acknowledging the inherent limitations of single-group designs in terms of internal validity, this approach was deemed appropriate given ethical considerations and practical constraints inherent in educational research contexts (Alharbi et al., 2024).

Population and sample

The target population comprised 84 fourth-year nursing students enrolled at Boromarajonani College of Nursing, Uttaradit, Thailand. Sample size estimation was conducted using G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007), which indicated that a minimum of 30 participants would yield 80% statistical power to detect a medium effect size (f = 0.25) with an alpha level of 0.05, suitable for repeated measures analysis across four time points. To ensure representation across varying academic performance levels, stratified random sampling was employed. Participants were selected proportionally from three GPA strata:

1. High GPA (3.50–4.00): 10 students
2. Medium GPA (3.00–3.49): 10 students
3. Lower GPA (2.50–2.99): 10 students

Research instruments

1. Simulation-Based Instructional Model

The 12-week instructional intervention was developed through an iterative process involving a comprehensive literature review, expert panel consultation, and pilot testing. The expert panel consisted of:

(1) Two emergency nursing educators
(2) Two clinical emergency nurses
(3) One simulation education specialist

The model comprised three phases:

Phase 1: Preparation (Weeks 1–2)

(1) Theoretical foundation sessions (6 hours)
(2) Simulation environment orientation (3 hours)
(3) Basic skills review workshops (6 hours)

Phase 2: Core Implementation (Weeks 3–10) Weekly 3-hour simulation sessions included:

(1) Pre-briefing (30 minutes)
(2) Simulation scenario (45 minutes)
(3) PEARLS-structured debriefing (75 minutes) (Hosseini et al., 2023)
(4) Skills reinforcement activities (30 minutes)

Phase 3: Integration (Weeks 11–12)

(1) Complex scenario management
(2) Team-based simulations
(3) Comprehensive skills assessment

2. Emergency Nursing Knowledge Assessment

A 50-item multiple-choice test was developed to evaluate theoretical knowledge aligned with the instructional model. The test covered five domains, with 10 items per domain:

(1) Patient assessment
(2) Clinical decision-making
(3) Emergency interventions
(4) Pharmacology
(5) Team management

Content validity was confirmed through expert review (CVI = 0.87), and internal consistency reliability was established using Cronbach's alpha (α = 0.85) (Sim, Acharya, & Sethi, 2022).

3. Emergency Nursing Skills Performance Assessment

This checklist-based tool was used to assess student performance across five simulated emergency scenarios. Each scenario evaluated:

(1) Technical skills (25 items)
(2) Non-technical skills (25 items)
(3) Total possible score: 50 points

Inter-rater reliability was confirmed through pilot testing with two trained evaluators, yielding an intraclass correlation coefficient (ICC) of 0.92 (Lee, Han, Park, Min, & Park, 2022).

Data collection

Baseline data were collected one week prior to implementation of the instructional intervention. The simulation-based program was delivered according to standardized protocols:

1. Weekly 3-hour sessions
2. A consistent facilitator team throughout the intervention
3. A fixed student-to-instructor ratio (5:1)
4. Standardized debriefing using the PEARLS framework

Post-intervention data were collected at three time points:

1. Week 4: Immediate post-test
2. Week 8: Intermediate follow-up
3. Week 12: Final assessment

Data analysis

Data analysis was performed using statistical software to examine both descriptive and inferential outcomes. The following procedures were employed:

1. Descriptive statistics - used to summarize demographic characteristics of the participants
2. Repeated measures ANOVA - conducted to evaluate changes in knowledge and skills scores across the four time points
3. Pearson correlation coefficients - calculated to explore the relationship between emergency nursing knowledge and skills performance
4. Multiple regression analysis - performed to identify significant predictors of emergency nursing competence
5. Mauchly's test for sphericity - applied to assess the assumption of sphericity in repeated measures ANOVA. When violations occurred, the Greenhouse-Geisser correction was used to adjust degrees of freedom

Statistical significance was set at $p < .05$ for all analyses.

Ethical considerations

The study received ethical approval from the Institutional Review Board of Boromarajonani College of Nursing, Uttaradit (Approval No. 012/2566). The research protocol adhered to established ethical guidelines for simulation-based and educational research, as recommended by the INACSL Standards Committee (2016) and Polit and Beck (2017).

Key ethical provisions included:

1. Informed consent from all participants
2. Right to withdraw without academic consequences
3. Data confidentiality and secure storage
4. Access to counseling services
5. Protection of participant privacy

Results

The findings of this study are presented in three main sections: sample characteristics, effects of simulation-based learning on emergency nursing competence, and correlation analyses.

Section 1: Sample Characteristics

Table 1 presents the demographic characteristics of the study participants (n = 30). The majority were female (96.66%, n = 29), with a mean age of 21.4 years (SD = 0.8). Academic performance was evenly distributed across three GPA strata through stratified random sampling (33.33% in each category). Most participants (83.33%, n = 25) held Basic Life Support certification,

Table 1 Demographic Characteristics of Study Participants (n = 30)

Characteristic	n	Percentage
Gender		
Female	29	96.66
Male	1	3.34
Academic Performance		
High GPA (3.50–4.00)	10	33.33
Medium GPA (3.00–3.49)	10	33.33
Lower GPA (2.50–2.99)	10	33.33
Prior Clinical Experience		
Emergency room rotation	18	60.00
Basic life support certified	25	83.33

and 60% (n = 18) had completed emergency room rotations prior to the study.

Section 2: Effects of Simulation-Based Learning on Emergency Nursing Competence

Analysis of emergency nursing knowledge scores revealed statistically significant improvements across all measurement points. A repeated measures ANOVA indicated a significant effect of time on knowledge scores, $F(2.14, 62.06) = 1471.929$, $p < .001$, partial $\eta^2 = .981$, suggesting a strong effect of the simulation-based instruction models on knowledge acquisition.

Mauchly's test of sphericity revealed a violation of the sphericity assumption, ($\chi 2(5) = 53.62$, $p < .001$). Accordingly, the Greenhouse-Geisser correction was applied ($\varepsilon = .714$) to adjust degrees of freedom.

Table 2 Emergency Nursing Knowledge Scores Across Time Points

Time Point	M	SD	F	p	partial η²
Baseline	29.20	1.66	1471.929	< .001	.981
Week 4	35.03	9.28			
Week 8	40.86	9.96			
Week 12	44.86	8.66			

Skills performance demonstrated a consistent pattern of progressive improvement across the intervention period. A repeated measures ANOVA revealed a significant effect of time on skills scores, $F(2.32, 67.28) = 970.392$, $p < .001$, partial $\eta^2 = .971$, indicating a substantial impact of the simulation-based instructional model on skill development. Mauchly's test of sphericity indicated a violation of the sphericity assumption, $\chi 2(5) = 41.75$, $p < .001$. The Greenhouse-Geisser correction was applied ($\varepsilon = .773$) to adjust for this violation.

Table 3 Emergency Nursing Skills Performance Scores Across Time Points

Time Point	M	SD	F	p	partial η²
Baseline	29.50	1.52	970.392	< .001	.971
Week 4	35.00	9.27			
Week 8	40.10	10.79			
Week 12	44.20	9.78			

Section 3: Correlation and Regression Analyses

Strong positive correlations were observed between emergency nursing knowledge and skills scores across all time points, ranging from r = 0.720.85, p<.001, indicating a consistent relationship between cognitive and performance domains throughout the intervention. Multiple regression analysis identified baseline performance as the strongest predictor of post-intervention improvement. Specifically, baseline scores significantly predicted gains in both knowledge ($\beta = 0.56$, $p<.001$) and skills ($\beta = 0.61$, $p<.001$).

Table 4 Correlation Between Knowledge and Skills Scores

Time Point	Correlation Coefficient (r)	p-value
Baseline	0.72	< .001
Week 4	0.78	< .001
Week 8	0.82	< .001
Week 12	0.85	< .001

Post-hoc analyses using Bonferroni correction revealed statistically significant improvements between all consecutive time points for both knowledge and skills assessments ($p < .001$). The most substantial gains occurred between baseline and Week 4, with continued incremental improvement observed through Week 12.

Neither gender nor prior clinical experience significantly predicted performance improvement ($p > .05$), suggesting that the instructional model was broadly effective across demographic subgroups.

Overall, these results demonstrate the effectiveness of the simulation-based instructional model in enhancing both theoretical knowledge and practical skills in emergency nursing. The sustained improvement over the 12-week intervention period underscores the value of structured experiential learning in developing clinical competence.

Discussion

The findings of this study demonstrate significant improvements in emergency nursing competence resulting from simulation-based education, while offering valuable insights into instructional design and implementation strategies.

Primary Findings and Theoretical Implications

Substantial gains were observed in both knowledge and skills domains, with the most pronounced improvements occurring within the first four weeks of the intervention. This trajectory aligns with Kolb's Experiential Learning Cycle, which emphasizes the importance of early concrete experiences and reflective observation in establishing a foundation for deeper learning (Mulyadi et al., 2021). The strong correlation between knowledge and skills scores (r = 0.85) reinforces the study's theoretical proposition that theoretical understanding and practical capability develop synergistically through simulation-based instructional models. These results affirm the value of integrating cognitive and performance-based learning objectives with simulation-based instructional models.

Competency Development Trajectory

The progressive improvement observed across all time points—from baseline to Week 12—indicates a cumulative learning effect, consistent with the principles of experiential and scaffolded instructions. Among the assessed domains, team management yielded the highest final scores (9.2±0.6), suggesting that simulation is particularly effective in enhancing collaborative competencies (Tong et al., 2024). This finding extends prior research by demonstrating that structured simulation experiences can simultaneously develop both technical and non-technical skills, including communication, coordination, and clinical reasoning (Hamdi & Al Thobaity, 2023).

Implementation Challenges and Solutions

Several implementation challenges were encountered during the study, each addressed through targeted strategies that preserved instructional integrity and learning outcomes:

1. Resource Management:

Challenge: Limited access to high-fidelity simulators (2 units for 30 students)

Solution: Developed rotational system using skill stations to distribute simulation access equitably

Impact: Maintained learning effectiveness while optimizing resource utilization. This approach aligns with recent recommendations for resource-efficient simulation delivery in constrained educational environments (Park et al., 2024).

2. Faculty Development:

Challenge: Need for specialized facilitation and debriefing skills among faculty

Solution: Implemented a peer-mentoring system to support faculty development

Outcome: Enhanced faculty confidence and competence in simulation facilitation. These findings support emerging evidence about the critical role of faculty preparation in simulation-based education (Kiegaldie & Shaw, 2023).

3. Student Engagement:

Challenge: Varying levels of preparedness and simulation-related anxiety

Solution: Adopted a progressive complexity model with gradually increasing scenario difficulty

Result: Anxiety was reduced while maintaining learning gains. This structured approach addresses known barriers to simulation effectiveness and supports learner-centered design principles (Wang et al., 2024).

Methodological Considerations and Limitations

While the study yielded valuable insights into simulation-based emergency nursing education, several methodological limitations warrant consideration:

1. Study Design:

(1) The use of a single-group pretest-posttest design limits the ability to draw causal inferences.

(2) The small sample size (n=30) may affect the generalizability of findings.

(3) Future research should consider randomized controlled trial designs with larger and more diverse samples to strengthen validity (Alharbi et al., 2024)

2. Measurement Limitations:

(1) Reliance on self-reported confidence measures may not accurately reflect actual clinical competence.

(2) Clinical outcome data was limited.

(3) The development of objective performance measures remains essential for advancing simulation research (Nair et al., 2024).

3. Contextual Constraints:

(1) Single-institution study within the Thai nursing education system

(2) The intervention was implemented in a resource-rich simulation environment, which may not reflect conditions in lower-resource settings. These contextual factors may limit generalizability to different settings (Lee, Han, Park, Min, & Park, 2024).

Educational Implications

The study findings offer key implications for the design and delivery of nursing education, particularly in simulation-based instructional contexts:

1. Curriculum Integration:

(1) Simulation should be systematically embedded within the nursing curriculum

(2) Scenarios should follow a progressive complexity model, allowing learning to build competence incrementally.

(3) Regular assessment cycles are essential to monitor the development and reinforce learning. This structured approach supports optimal competency development (Jung & Roh, 2022).

2. Learning Environment:

(1) Maintain an optimal student-facilitator ratio (5:1), ensuring individualized feedback and engagement.

(2) Use standardized debriefing protocols (such as PEARLS framework) to enhance reflective learning.

(3) Provide adequate practice time within sessions to support skill mastery. These factors significantly influence learning outcomes and learner satisfaction (Hosseini et al., 2023).

3. Performance Support:

(1) Early identification of students who struggle with simulation tasks allows for timely intervention.

(2) Targeted instructional strategies and interventions

(3) Regular progress monitoring can help close performance gaps. Evidence-based support systems enhance learning effectiveness (Sim et al., 2022).

Future Research Directions

Building on the findings and limitations of this study, future research should explore the following areas to advance simulation-based nursing education:

1. Long-term Retention and Transferability:

(1) Conduct longitudinal studies to examine the sustainability of skill acquisition over time.

(2) Investigate the transfer of simulation-acquired competencies to real-world clinical practice. These efforts are critical for understanding the durability and practical relevance of simulation-based learning (Shorey & Ng, 2021).

2. Comparative Effectiveness and Resource Efficiency:

(1) Evaluate the effectiveness of different simulation modalities (virtual, hybrid and high-fidelity formats).

(2) Perform cost-effectiveness analysis to inform strategic resource allocation. Such studies are essential for optimizing instructional investments and tailoring approaches to institutional capacities (Huai et al., 2024).

3. Implementation Science and Scalability:

(1) Explore factors that influence successful integration of simulation into curricula.

(2) Examine scalability models to support broader adoption across diverse educational contexts (Liu, Zhang, Li, Wang, & Zheng, 2023).

This study contributes to the growing body of evidence supporting simulation-based education in emergency nursing, while highlighting key considerations for implementation and future research. The findings provide a foundation for evidence-based decisions regarding the integration of simulation into nursing education programs, though careful attention to local context and resources availability remains essential to ensure effective and sustainable adoption.

Suggestions

Based on the findings of this study, the following evidence-based recommendations are proposed to guide curriculum development and instructional practice in nursing education:

1. Curriculum Development and Implementation

(1) Systematically integrate simulation across the nursing curriculum, focusing on progressive complexity in emergency care scenarios.

(2) Design structured learning modules that scaffold competency development from basic to advanced emergency nursing skills.

(3) Adopt standardized assessment protocols to monitor student progress across both knowledge and skills domains.

(4) Maintain optimal student-to-facilitator ratios of 5:1, as supported by the study's outcomes, to ensure individualized feedback and effective learning.

2. Faculty Development

(1) Offer comprehensive training in simulation facilitation and structured debriefing techniques to ensure instructional quality.

(2) Establish mentoring programs to support new simulation facilitators and promote continuous professional growth.

(3) Create collaborative networks for sharing simulation resources, scenario designs, and best practices across institutions.

(4) Promote faculty expertise in the PEARLS debriefing methodology, which demonstrated significant impact on learning outcomes.

3. Student Support Systems

Drawing on the strong correlation findings observed between knowledge and skills ($r = 0.72–0.85$), the following strategies are recommended to enhance learner outcomes:

(1) Implement early identification systems to detect students requiring additional support.

(2) Provide targeted remediation tailored to specific competency gaps in the cognitive and performance domains.

(3) Establish peer support programs, leveraging high-performing students as mentors to foster collaborative learning.

(4) Offer additional practice opportunities in areas of identified weakness to reinforce skill acquisition and confidence.

4. Quality Assurance

Based on the longitudinal assessment findings, the following measures are recommended to ensure ongoing effectiveness and fidelity of simulation-based education:

(1) Conduct regular evaluations of simulation outcomes.

(2) Monitor and maintain simulation equipment and facility standards.

(3) Update simulation scenarios based on current evidence and practice guidelines.

(4) Track long-term retention of skills and knowledge to evaluate sustained competency development.

5. Research Advancement

To address the limitations identified in this study and strengthen the evidence base for simulation-based education:

(1) Conduct multi-center studies to enhance generalizability.

(2) Investigate long-term retention of emergency nursing competencies beyond the intervention period.

(3) Evaluate the transferability of simulation-acquired skills to real-world clinical practice.

(4) Assess the cost-effectiveness of various simulation modalities to inform resource allocation and instructional design.

Implementation Framework

Short-term Goals (0–12 months):

1. Establish standardized simulation protocols to ensure consistency and instructional fidelity.
2. Train core faculty team in simulation pedagogy, facilitation, and debriefing techniques.
3. Develop fundamental emergency care scenarios targeting baseline competencies.
4. Implement baseline competency assessments to identify learner needs and track initial performance.

Medium-term Goals (1–2 years):

1. Expand scenario complexity based on student performance data and evolving curricular needs.
2. Integrate interprofessional simulation experiences to promote collaborative practices.
3. Establish research protocols for ongoing evaluation of simulation effectiveness.
4. Develop regional simulation networks to share resources, expertise, and best practices.

Long-term Goals (2–5 years):

1. Achieve simulation center accreditation to validate quality and institutional commitment.
2. Establish evidence-based best practices for simulation design, delivery and evaluation.
3. Create innovative simulation methodologies, including hybrid and virtual formats.
4. Contribute to the development of national simulation education standards for nursing programs.

Essential Resources and Support

Based on the study's implementation experience, the following resources are critical for successful integration:

1. Dedicated simulation laboratory space
2. High-fidelity simulators and task trainers
3. Audiovisual recording equipment for debriefing and review
4. Simulation technician support for operational continuity
5. Ongoing faculty development resources

Monitoring and Evaluation

Drawing from the study's assessment methods, the following are recommended for continuous quality improvement:

1. Regular competency assessments
2. Student feedback surveys
3. Faculty performance evaluations
4. Outcome tracking systems
5. Cost-benefit analyses

These recommendations are directly derived from the study's findings and aim to enhance emergency nursing education through evidence-based simulation practices. Implementation should be tailored to institutional resources and contextual factors, with a sustained focus on measurable outcomes and continuous quality improvement.

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