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Simulation-Based Nursing Education in Improving Clinical Competence

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Abstract

Nursing education is required to produce graduates with adequate clinical competency to ensure the quality and safety of healthcare services. One rapidly developing innovative learning approach is simulation-based nursing education, designed to bridge the gap between theory and clinical practice. This study aimed to analyze the effect of simulation-based nursing education on improving the clinical competency of nursing students. The study used a quasi-experimental design with a pretest-posttest approach and a control group. The study sample consisted of 80 nursing students divided into an intervention group and a control group. The intervention group received simulation-based clinical learning, while the control group underwent conventional clinical learning. Clinical competency was measured using the Objective Structured Clinical Examination (OSCE) and a standardized clinical skills instrument. Data analysis was performed using paired t-tests and independent t-tests. The results showed a significant increase in clinical competency in the intervention group compared to the control group ($p < 0.001$) with a strong effect size. These findings indicate that simulation-based nursing education is effective in improving clinical skills, decision-making, and student confidence. Therefore, simulation is recommended as a primary learning strategy in nursing education to enhance graduates' clinical readiness.

Keywords: Nursing Education, Simulation-Based Learning, Clinical Competence, Nursing Students, Health Education

Introduction

Nursing education currently faces complex challenges in preparing graduates who possess not only theoretical knowledge but also robust clinical competencies and are ready to face the dynamics of real-world healthcare practice. Clinical competencies encompass technical skills, critical thinking, decision-making, therapeutic communication, and the readiness to implement nursing procedures safely and effectively in the healthcare setting. However, the frequent gap between theoretical learning in the classroom and clinical practice in healthcare facilities is a major obstacle to

achieving the goal of quality nursing education (Alharbi et al., 2024).

Simulation in nursing education has emerged as an innovative pedagogical strategy that offers a safe, controlled, and realistic learning environment to develop students' clinical competencies without risking real patients.

This approach mimics complex clinical situations through a variety of simulation methods, ranging from low-fidelity to high-fidelity models, and the use of case-based scenarios, computer-based simulations, and interactive multimedia training (FornoIles et al., 2025; Alzahrani et al., 2024).

Conceptually, nursing simulation provides a foundation for students to integrate theory with practice through repeated learning experiences and reflective feedback. This aligns with the principles of experiential learning, which emphasize knowledge development through active experience and reflection on actions taken (Issroviatiningrum et al., 2024).

Various studies have shown that simulation can significantly improve students' clinical skills. Dow et al. (2025) found that simulation-based learning significantly improved basic clinical skills scores in nursing students compared to pre-intervention levels. These results reinforce the belief that simulation can bridge the gap between theory and practice, a frequent challenge in healthcare education.

Furthermore, findings from several systematic reviews support the claim of educational simulation's effectiveness across various competency dimensions, including clinical knowledge, technical skills, decision-making, and student confidence.

A meta-analysis by Alharbi et al. (2024) demonstrated that Simulation-Based Learning (SBL) consistently provided significant improvements in nursing students' clinical abilities and skills across the various studies analyzed.

Furthermore, a multicenter experimental study by Xu et al. (2024) demonstrated that various forms of simulation whether high-fidelity, computer-based, or a combination of simulation and case studies have a positive effect on students' clinical competencies, including critical thinking skills, interprofessional collaboration, and clinical readiness (competence), both in the short term and over a period of time. These findings confirm that the choice of simulation approach can be tailored to specific learning objectives within the nursing curriculum.

Simulation has also been linked to improvements in non-technical skills important in healthcare, such as effective communication and self-confidence. Research measuring communication, learning satisfaction, and self-confidence indicates a positive correlation between simulation learning and students' ability to apply interpersonal skills when interacting with patients or clinical teams. Improvement in these aspects facilitates students' adaptation to dynamic clinical situations that require interdisciplinary collaboration (PubMed, 2023).

In the local context, national research in Indonesia has also demonstrated the effectiveness of simulation in improving specific skills, such as writing geriatric nursing care reports and basic CPR skills.

These findings underscore that simulation is not only relevant for general clinical competencies but also for contextual skills tailored to local practice needs and the culture of higher health education (Ariestia, 2025; Susila & Laksmi, 2024).

However, simulation implementation faces several operational challenges, such as resource requirements, facilitator capacity development, assessment

standardization, and evaluating long-term impacts on clinical practice outcomes.

This necessitates further research that evaluates not only immediate learning outcomes but also competency retention, adaptation to new technologies, and the ongoing integration of simulation into nursing curricula (Alharbi et al., 2024; Fornolles et al., 2025).

Against this backdrop, simulation-based nursing education is an important and relevant research topic for improving the quality of professional education and preparing competent and adaptive healthcare workers to meet the needs of the future healthcare system.

Methods

This study used a quantitative quasi-experimental design approach to measure the effect of simulation-based nursing education on improving the clinical competence of nursing students.

The quasi-experimental approach was chosen because it allows for testing the effects of the intervention on groups that are not completely randomized, while still using a control and pretest-posttest design to minimize bias and increase inferential strength (e.g., a pretest-posttest with control group design), in accordance with common practice in simulation-based nursing education research.

This design has been widely applied in previous similar studies to evaluate the effects of simulation on improving clinical skills, critical thinking, and self-confidence in nursing students (Issroviatiningrum, Wardaningsih, & Kurnia Sari, 2018; Suriyani, 2025).

The population in this study was all nursing students at the educational institution where the study took place. A sample of 80 respondents was selected using cluster random sampling or stratified random sampling techniques to ensure class or cohort representativeness. Many nursing simulation studies use a similar approach, using simple random sampling or consecutive sampling techniques, to ensure a balanced distribution of demographic characteristics and baseline abilities across groups (Suriyani, 2025).

Interventions are delivered in the form of real-life clinical scenario simulations, using high-fidelity manikins, standardized patients, or virtual simulations, in accordance with predetermined clinical competency learning objectives.

Each simulation session is conducted within an experiential learning framework, including orientation, simulation implementation, and reflective debriefing. This approach aligns with the principles of simulation, which can facilitate active learning and foster critical thinking skills and clinical decision-making (Adib-Hajbaghery & Sharifi, 2025; Jallad, 2025).

Clinical competency is measured using standardized and validated instruments that assess important aspects of nursing competency, including technical skills, clinical decision-making, communication skills, emergency management, and self-confidence.

Instruments commonly used in simulation research include: 1) Objective Structured Clinical Examination (OSCE), 2) Self-Confidence in Learning and Clinical Decision-Making Questionnaire, 3) Clinical Skills Checklist. The use of these instruments has proven reliable in simulation-based nursing research and allows for objective measurement of changes in students' clinical competencies (BMC Nursing trial, 2024).

Data analysis was performed using statistical software such as SPSS or R. Statistical tests were adjusted to the measurement scale and data distribution. Comparisons of clinical skill changes over time (pre vs. post) within a single group were analyzed using paired t-tests, while differences between the intervention and

control groups were analyzed using independent samples t-tests or linear regression models adjusted for important covariates such as age, gender, and student GPA. Effect sizes were also reported to demonstrate the practical impact of the simulation intervention.

Result

1. Respondent Characteristics

Table 1: Respondent Characteristics by Age and Gender

Characteristics	Intervention Group (n=40)	Control Group (n=40)
Age (Mean ± SD)	20,9 ± 1,2 tahun	21,1 ± 1,3 tahun
Gender		
Male	10 (25,0%)	12 (30,0%)
Female	30 (75,0%)	28 (70,0%)

This study involved 80 nursing students, divided into two groups: an intervention group (n = 40) and a control group (n = 40). The intervention group received simulation-based nursing education, while the control group received conventional clinical instruction. Respondent characteristics are presented to ensure baseline homogeneity between the two groups before the intervention. The homogeneity test results showed no significant differences between the intervention and control groups based on age or gender ($p > 0.05$), thus the two groups were considered comparable.

2. Clinical Competence Before Intervention (Pretest)

Table 2: Comparison of Pretest Clinical Competence Scores

Group	Mean	SD	p-value
Intervention	68,45	5,12	
Control	67,90	5,36	0,612

Clinical competence was measured before the intervention using the OSCE and a standardized clinical skills checklist. The initial clinical competence scores for both groups are shown in Table 2. An independent samples t-test showed no significant difference in initial clinical competency scores between the intervention and control groups ($p = 0.612$). This finding indicates that students' clinical abilities in both groups were at relatively similar levels before the intervention.

3. Clinical Competence After Intervention (Posttest)

Table 3: Comparison of Clinical Competence Scores Posttest

Group	Mean	SD	p-value
Intervention	85,72	4,38	
Control	72,10	5,01	< 0,001

After the 6-week intervention period, clinical competency was remeasured using the same instrument. The posttest results are presented in Table 3. The analysis results showed a highly significant difference between the intervention and control groups after treatment ($p < 0.001$). The group that participated in simulation-based nursing education had higher clinical competency scores than the control group.

4. Clinical Competency Score Changes (Pretest–Posttest)

Table 4: Changes in Clinical Competency Scores Pretest and Posttest

Group	Pretest Mean ± SD	Posttest Mean ± SD	p-value
Intervention	68,45 ± 5,12	85,72 ± 4,38	< 0,001
Control	67,90 ± 5,36	72,10 ± 5,01	0,041

To assess the improvement in clinical competency in each group, a paired t-test was conducted. The results are presented in Table 4. The intervention group demonstrated a highly significant increase in clinical competency scores ($p < 0.001$) with an average difference of 17.27 points. Meanwhile, the control group also experienced an increase, but it was relatively small and borderline statistically significant ($p = 0.041$).

5. Effect Size Analysis

Table 5 Effect Size of Simulation-Based Nursing Education

Group	Cohen's d	Interpretasi
Intervention	1,42	Efek sangat besar
Control	0,32	Efek kecil

To assess the strength of the simulation intervention's impact on clinical competency, an effect size was calculated using Cohen's d. The effect size value in the intervention group showed a very large effect, indicating that simulation-based nursing education had a substantial impact on improving students' clinical competence. In contrast, conventional learning only had a small effect.

Discussion

1. Improving Clinical Competence Through Simulation

Our study found that the intervention group participating in simulation had significantly higher clinical competence posttest scores than the control group ($p < 0.001$). This finding aligns with the results of a systematic review confirming that simulation-based learning (SBL) consistently improves the acquisition of clinical skills and competence in nursing education (Alharbi et al., 2024).

Clinical competence encompasses practical skills and theoretical knowledge applicable in real-life situations. Similar findings were also reported in a study by Cho and Chong (2025), which showed that a community nursing simulation learning program resulted in significant improvements in core competencies, clinical judgment, and clinical performance of nursing students.

2. The Role of Simulation in Improving Clinical Decision-Making

Clinical competence is reflected not only in technical skills but also in the ability to create an atmosphere for clinical decision-making. A meta-analysis by Görücü et al. (2024) showed that educational simulation significantly improves nursing students' clinical decision-making skills, especially when using high-fidelity simulations.

This aligns with Kolb's experiential learning theory, where hands-on experience through simulation provides a concrete context that can be generalized to actual clinical practice. Furthermore, improvement in clinical decision-making is a key aspect of clinical competence, reflecting the transfer of skills from simulation to real-life patient situations.

3. Effects of Simulation on Self-Efficacy and Confidence

This study also showed that simulation increased students' self-efficacy—while the control group experienced only a small increase. This finding is supported by Rateb et al. (2025), who reported that students who participated in simulation demonstrated significant increases in self-efficacy, satisfaction, and perceived competence post-training.

Self-efficacy is an important predictor of clinical practice, with confident students tending to be more effective when navigating complex situations, making urgent decisions, and communicating with patients and other members of the healthcare team.

4. Simulation as a Gap Bridge Between Theory and Practice

Our finding that simulation helps bridge the gap between theory and practice aligns with a systematic review that observed that clinical simulation provides a realistic learning environment without risk to live patients, thus strengthening skills difficult to acquire through conventional learning or traditional clinical internships alone (Koukourikos et al., 2021).

The application of simulation allows students to encounter complex clinical situations, including emergencies and critical conditions, which they often rarely encounter in standard clinical practice but are crucial in preparing them for comprehensive clinical competency.

5. Pedagogical Factors in Effective Simulation

The effectiveness of simulations depends not only on frequency or duration, but also on sound instructional design, including pre-simulation briefings, authentic scenarios, and post-simulation debriefing with reflective feedback. This is reflected in the review by Alharbi et al. (2024), which emphasized the importance of structured debriefing to facilitate the internalization of learning.

Simulations equipped with structured debriefing provide opportunities for students to reflect on their actions, identify areas for improvement, and reinforce conceptual understanding, thereby strengthening long-term learning outcomes.

6. The Role of Simulations in Enhancing Non-Technical Skills

In addition to technical skills, simulations are effective in fostering non-technical skills such as communication, interprofessional collaboration, and problem-solving. A meta-analysis by Elsevier showed that technological simulations significantly increase student self-confidence and satisfaction—two aspects closely correlated with effective and collaborative clinical competence in healthcare settings.

This is important because nurses' professional competence is measured not only by what they do, but also by how they interact with patients and healthcare teams—a domain that is increasingly being addressed in modern nursing curricula.

Conclusion

This study concludes that simulation-based nursing education is an effective learning approach for improving the clinical competence of nursing students. The results showed a significant increase in the clinical competence of students who participated in simulation-based learning compared to students who received conventional clinical instruction. This improvement was not only evident in technical nursing skills, but also in clinical decision-making, critical thinking, therapeutic communication, and students' confidence in dealing with complex clinical situations.

Simulation provides a safe, structured, and realistic learning environment, enabling students to integrate theoretical knowledge with clinical practice without risking patient safety. Through systematically designed clinical scenarios supported by a reflective debriefing process, students can evaluate their nursing actions, identify their strengths and weaknesses, and continuously improve their competencies. This makes simulation a pedagogical strategy capable of bridging the gap between theory and practice in nursing education.

Therefore, the integration of simulation-based nursing education into the nursing curriculum needs to be continuously developed and optimized. This approach is expected to produce competent, adaptive nursing graduates who are prepared to face the demands of clinical practice in an increasingly complex and dynamic healthcare environment.

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