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Effectiveness of Clinical Simulation-Based Learning on Improving Clinical Competency Among Nursing Professional Education Students

Fistaqul Isnaini[1], Dwi Ris Hasanah S[2]

[1,2] Sekolah Tinggi Ilmu Kesehatan Darmo, Medan, Indonesia

Corresponding Author: rishasanahdwi@gmail.com

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ABSTRAK

Clinical competency is a critical outcome of nursing professional education programs (Ners). Conventional teaching methods have been shown to yield suboptimal competency development, particularly in clinical decision-making and psychomotor skills. This study aimed to examine the effectiveness of clinical simulation-based learning in improving clinical competency among nursing professional education students at a private university in Medan, Indonesia. A quasi-experimental study with a pre-test–post-test control group design was conducted involving 60 nursing professional students selected through total sampling. Participants were divided equally into an intervention group (n=30) receiving clinical simulation-based learning and a control group (n=30) receiving conventional learning. Clinical competency was assessed using the Clinical Competency Assessment Tool (CCAT), evaluated across four domains: cognitive, psychomotor, affective, and clinical reasoning. Data were analyzed using paired t-test and independent t-test with a significance level of $p<0.05$. The intervention group demonstrated a significant improvement in mean clinical competency scores from 62.4 (± 8.3) pre-test to 84.7 (± 6.1) post-test ($p<0.001$, Cohen's $d=2.87$). The control group showed a modest improvement from 61.9 (± 7.8) to 69.2 (± 7.4) ($p=0.021$). The between-group difference at post-test was statistically significant ($p<0.001$), with the simulation group scoring significantly higher across all competency domains. Clinical simulation-based learning is significantly more effective than conventional methods in improving clinical competency among nursing professional students. Integration of simulation into Ners programs is strongly recommended to optimize graduate readiness for clinical practice.

Keywords: Clinical Competency; Simulation Training; Nursing Education; Professional Nursing; Quasi-Experimental Study

Implications for Research, Practice, or Policy

- Nursing education institutions in North Sumatra should adopt competency-based curriculum frameworks aligned with hospital accreditation standards to reduce the identified gaps in clinical decision-making and digital health literacy.
- Hospital management at RSI Malahayati and RSUA should establish structured internship and preceptorship programs that systematically bridge the gap between theoretical knowledge and clinical application during the transition period for newly graduated nurses.
- The Indonesian Ministry of Health and Ministry of Education should develop joint policy instruments that mandate periodic labor market needs assessments and curriculum review mechanisms between nursing professional programs and accredited hospitals at the regional level.

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INTRODUCTION

Clinical competency constitutes the cornerstone of nursing professional education, particularly within the Ners (Professional Nurse) program in Indonesia. It encompasses a complex integration of cognitive knowledge, psychomotor skills, clinical reasoning, and affective dispositions, all of which are essential for providing safe and effective patient care (Benner et al., 2010; Levett-Jones et al., 2022). Globally, the preparation of nursing graduates who are competent from day one of clinical practice has remained a persistent challenge, prompting healthcare educators to explore innovative pedagogical approaches.

The World Health Organization (WHO) has identified a critical shortage of competent healthcare workers across low- and middle-income countries, with an estimated global deficit of 15 million health workers projected by 2030 (WHO, 2021). In Indonesia, the Nursing Competency Examination (Uji Kompetensi Ners / UKOM) serves as the national gatekeeping mechanism for nursing registration. However, pass rates have remained suboptimal, with national data from 2020–2023 indicating that approximately 35–45% of Ners graduates fail on their first attempt (AIPNI, 2023). These statistics highlight systemic deficiencies in clinical preparation within nursing education programs.

Conventional teaching methods, such as lecture-based instruction and limited bedside clinical exposure, have been shown to be insufficient for developing the complex competencies required in contemporary nursing practice (Harder, 2020). Students often graduate with theoretical knowledge but lack adequate practical skills and clinical judgment, particularly in high-acuity situations (Cant & Cooper, 2017). This gap between education and practice has been widely documented in the Indonesian context, especially within private nursing institutions that face constraints in clinical placement capacity (Wahyuningsih et al., 2021).

Clinical simulation-based learning (CSBL) has emerged as a transformative educational strategy that replicates real-world clinical environments in a safe, controlled, and reproducible setting (Gaba, 2004; Motola et al., 2013). Simulation provides students with opportunities to practice clinical procedures, respond to emergencies, and develop clinical reasoning without risk to actual patients. High-fidelity simulation, in particular, has been associated with significant improvements in knowledge, skill performance, confidence, and clinical decision-making (Cant & Cooper, 2017; Hayden et al., 2014).

Several international studies have demonstrated the effectiveness of simulation in nursing education. A systematic review by Hegland et al. (2017) found that simulation significantly improved both technical and non-technical nursing skills. Similarly, Hayden et al. (2014) demonstrated in a landmark randomized controlled trial that up to 50% of traditional clinical hours could be substituted with simulation without compromising competency outcomes. However, evidence from Indonesian settings, particularly within private nursing education institutions, remains limited and contextually specific.

The theoretical basis of this study is grounded in Kolb's Experiential Learning Theory (ELT), which posits that learning is a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). Clinical simulation is ideally aligned with this framework as it creates a structured experiential environment that promotes reflection and iterative skill development. Additionally, Bandura's Self-Efficacy Theory supports the role of simulation in building students' confidence and perceived capability through mastery experiences and vicarious reinforcement (Bandura, 1997).

In the Indonesian context, research on CSBL has been growing but remains unevenly distributed across institutions. Most studies have been conducted at large public universities in Java, with limited evidence from private institutions in Sumatera, where resource disparities and infrastructure gaps are more pronounced (Wahyuningsih et al., 2021; Nurhayati & Suryani, 2022). This represents a significant research gap that warrants urgent attention given the role of private institutions in producing a large proportion of Indonesia's nursing workforce.

This study was conducted at a private nursing institution located in Medan, North Sumatera, which recently implemented a simulation laboratory as part of its commitment to improving educational quality. The present study aimed to evaluate the effectiveness of clinical simulation-based

learning in improving clinical competency among Ners students, providing contextually relevant evidence to guide curriculum development and resource allocation decisions at the institutional and policy levels.

The aim of this study was to determine the effectiveness of clinical simulation-based learning methods on improving clinical competency among nursing professional education (Ners) students at a private university in Medan, North Sumatera, Indonesia.

METHODS

Study Design

This study employed a quasi-experimental research design with a pre-test–post-test control group approach. This design was selected because randomization was not feasible due to pre-existing class groupings in the Ners program. The study was conducted from March to June 2024 at a private university located in Medan Johor District, Medan, North Sumatera, Indonesia, which has a fully equipped clinical simulation laboratory.

Participants

The study population comprised all Ners program students enrolled in the 2023/2024 academic year who were in the first semester of the professional education phase. The total sampling technique was applied, resulting in 60 eligible participants who met the inclusion criteria.

Inclusion criteria were: (1) actively enrolled in the Ners program in the 2023/2024 academic year; (2) willing to participate and provide informed consent; and (3) not having prior formal clinical simulation training. Exclusion criteria were: (1) students with a history of clinical anxiety disorder requiring medical management; (2) incomplete attendance (≥20% absence during the study period); and (3) withdrawal of consent during the study.

Participants were allocated into two groups: the intervention group (n=30) received clinical simulation-based learning, and the control group (n=30) received conventional learning methods including lectures and textbook-based case discussions. A sample size calculation using G*Power 3.1 (two-sample t-test, α=0.05, power=0.80, effect size d=0.8) confirmed that 30 participants per group was adequate.

Instrument

Clinical competency was measured using the Clinical Competency Assessment Tool (CCAT), adapted from the Nursing Competency Assessment Scale (NCAS) developed by Watson et al. (2002) and contextualized for Indonesian Ners students by Nurhayati and Suryani (2022). Permission to use and adapt the instrument was obtained directly from the original authors via email correspondence.

The CCAT consists of 40 items distributed across four domains: (1) Cognitive competency (10 items); (2) Psychomotor competency (12 items); (3) Affective competency (9 items); and (4) Clinical reasoning (9 items). Items are rated on a 4-point Likert scale (1=not competent, 4=highly competent), yielding a total score range of 40–160, which was converted to a 0–100 scale for interpretation. Validity was confirmed through content validity index (CVI=0.89) and construct validity via confirmatory factor analysis. Reliability was established with Cronbach's α=0.87, indicating good internal consistency.

Intervention

The simulation-based learning intervention was conducted over six sessions (3 hours each) across three weeks, facilitated by trained nurse educators with certification in clinical simulation facilitation (SSH-Certified Healthcare Simulation Educator standards). Each session followed the structured simulation design framework: (1) Pre-briefing (20 minutes): orientation to objectives, environment, and equipment; (2) Simulation scenario (70 minutes): execution of standardized clinical scenarios using high-fidelity manikins (SimMan 3G); (3) Debriefing (90 minutes): structured reflection using the Debriefing for Meaningful Learning (DML) model.

Scenarios addressed the following clinical areas: airway management, cardiovascular emergencies, medication administration, wound care, and patient deterioration recognition. The control group participated in conventional learning comprising equivalent six sessions of lecture-based instruction and textbook-based case discussions on the same clinical topics, without simulation

exposure. Both groups continued standard clinical placement activities concurrently as part of the Ners curriculum.

Data Collection

Data were collected at two time points: before the intervention (pre-test, March 2024) and after the completion of all six sessions (post-test, June 2024). The CCAT was administered as a self-report questionnaire in both groups at both time points. Research assistants who were blind to group allocation assisted with data collection under the supervision of the principal investigator. Data collection took place in designated academic rooms at the university campus to ensure a standardized environment.

Data Analysis

Data analysis was performed using IBM SPSS Statistics version 26.0. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize participant characteristics and competency scores. The Shapiro–Wilk test was applied to assess normality of distribution. The paired t-test was used to compare pre- and post-test scores within each group, while the independent t-test was used to compare post-test scores between the intervention and control groups. Effect size was calculated using Cohen's d to determine the practical significance of differences. Statistical significance was set at $p<0.05$.

Ethical Consideration

This study was approved by the Health Research Ethics Committee of the institution, with ethical clearance number 042/EC-KEPK/IV/2024. All participants provided written informed consent prior to enrollment. Participation was voluntary, and participants were informed of their right to withdraw at any time without consequences. Data were anonymized and stored securely in password-protected files accessible only to the research team. No additional ethical approval was required beyond the institutional review, as all procedures were non-invasive and posed no risk to participants.

RESULTS

Sample Characteristics

Of the 60 participants, the majority were female (n=49, 81.7%). The mean age of the intervention group was 22.3 (± 1.2) years and 22.5 (± 1.4) years for the control group. No statistically significant differences were found between groups in age, sex, and previous GPA scores ($p>0.05$), confirming baseline comparability (Table 1).

Table 1. Characteristics of Study Participants (N=60)

Characteristic	Intervention Group (n=30)	Control Group (n=30)	p-value
Age, years, Mean (± SD)	22.3 (± 1.2)	22.5 (± 1.4)	0.543
Sex, n (%)			
Female	25 (83.3%)	24 (80.0%)	0.731
Male	5 (16.7%)	6 (20.0%)	
Previous GPA, Mean (± SD)	3.41 (± 0.22)	3.38 (± 0.25)	0.614

Note: Independent t-test for continuous variables; Chi-square test for categorical variables. GPA = Grade Point Average.

Hypothesis Testing: Effectiveness of Clinical Simulation

Table 2 presents the comparison of clinical competency scores within and between groups before and after the intervention. Within the intervention group, the mean competency score increased significantly from 62.4 (± 8.3) pre-test to 84.7 (± 6.1) post-test ($p<0.001$; Cohen's $d=2.87$, indicating a very large effect). The control group also showed a statistically significant but modest increase from 61.9 (± 7.8) to 69.2 (± 7.4) ($p=0.021$; Cohen's $d=0.94$). The between-group comparison at post-test revealed a highly significant difference ($p<0.001$), with the intervention group demonstrating substantially superior competency outcomes.

Table 2. Comparison of Clinical Competency Scores Within and Between Groups (N=60)

Group	Pre-test Mean (± SD)	Post-test Mean (± SD)	Mean Difference	p-value*	d
Intervention (n=30)	62.4 (± 8.3)	84.7 (± 6.1)	+22.3	<0.001	2.87
Control (n=30)	61.9 (± 7.8)	69.2 (± 7.4)	+7.3	0.021	0.94
Between groups p-value†	0.802	<0.001	–	–	–

*Note: *Paired t-test (within group); †Independent t-test (between groups). SD = Standard Deviation; d = Cohen's d.*

Domain-Specific Competency Outcomes

A domain-specific analysis of competency improvement is presented in Table 3. The most pronounced improvement in the intervention group was observed in the clinical reasoning domain (pre: 58.7 ± 9.1; post: 83.4 ± 7.2; $p<0.001$), followed by psychomotor competency (pre: 60.1 ± 8.6; post: 86.2 ± 6.8; $p<0.001$). Cognitive and affective domains also showed substantial and significant improvements. All domain differences between the intervention and control groups at post-test were statistically significant ($p<0.001$).

Table 3. Domain-Specific Clinical Competency Scores by Group and Time Point (N=60)

Domain	Intervention Pre	Intervention Post	Control Pre	Control Post
Cognitive	64.3 (± 9.0)	83.6 (± 6.5)*	63.8 (± 8.5)	70.1 (± 7.9)*
Psychomotor	60.1 (± 8.6)	86.2 (± 6.8)*	59.7 (± 8.2)	67.4 (± 7.6)*
Affective	66.2 (± 7.4)	84.0 (± 5.9)*	65.9 (± 7.1)	71.3 (± 6.8)*
Clinical Reasoning	58.7 (± 9.1)	83.4 (± 7.2)*	58.1 (± 8.7)	67.0 (± 7.5)*

*Note: Values are Mean (± SD). *p<0.001 between groups at post-test (Independent t-test). All within-group pre-to-post changes were statistically significant (p<0.05, Paired t-test).*

DISCUSSION

The findings of this study demonstrate that clinical simulation-based learning significantly improves clinical competency among nursing professional students, substantially exceeding the improvements observed in the control group receiving conventional instruction. These results are consistent with a robust body of international literature supporting the efficacy of simulation in nursing education (Cant & Cooper, 2017; Hayden et al., 2014; Hegland et al., 2017).

The very large effect size (Cohen's d=2.87) observed in the intervention group is particularly noteworthy and is aligned with the theoretical premise of Kolb's Experiential Learning Theory. Simulation creates a structured learning cycle in which students engage with concrete clinical experiences, reflect during debriefing, conceptualize learning, and actively experiment in subsequent scenarios (Kolb, 1984). The debriefing component, conducted using the DML model, likely played a pivotal role in consolidating experiential gains, as debriefing has been identified as the most educationally impactful component of simulation (Cheng et al., 2016).

The most pronounced domain-specific improvement was observed in clinical reasoning and psychomotor competency. This is consistent with findings by Motola et al. (2013), who reported that high-fidelity simulation environments uniquely promote the development of clinical judgment by exposing students to complex, dynamic patient scenarios that require rapid and informed decision-making under pressure. The deliberate practice afforded by repeated simulation exposure, free from patient safety concerns, enables iterative skill refinement in a manner that is not feasible in real clinical environments (Ericsson, 2004).

The control group's statistically significant but clinically modest improvement (mean difference = 7.3 points) may be attributed to continued standard clinical placement activities and natural learning progression during the study period. However, the magnitude of improvement was substantially lower than in the simulation group, reinforcing the insufficiency of conventional methods alone in achieving meaningful competency development within the professional nursing phase.

In the Indonesian context, these findings hold particular significance for private nursing institutions in Sumatera, which often face limited clinical placement capacity and greater variability in clinical supervisor quality (Wahyuningsih et al., 2021). Simulation offers a standardized, controlled, and reproducible alternative that decouples competency development from the constraints of clinical availability. This is especially relevant in the context of national UKOM pass rate improvement initiatives, where targeted simulation-based preparation has shown promise (AIPNI, 2023; Nurhayati & Suryani, 2022).

Bandura's Self-Efficacy Theory also provides a complementary explanatory lens for these findings. Repeated successful performance of clinical procedures within simulation environments is likely to enhance students' self-efficacy and confidence, which are known mediators of clinical performance (Bandura, 1997). Future studies should measure self-efficacy as a mediating variable to further elucidate the mechanisms underlying simulation effectiveness in the Indonesian nursing education context.

Practical Applications of the Findings

Healthcare educators and nursing program directors should prioritize the integration of structured clinical simulation modules into Ners curricula, with particular emphasis on high-acuity clinical scenarios and domains of clinical reasoning. Simulation-based assessments should be incorporated as a formal component of competency evaluation alongside traditional clinical supervisor assessments to provide a more objective, standardized measure of student readiness for independent practice.

Limitations

Several limitations should be acknowledged. First, the use of total sampling within a single institution limits the generalizability of findings to other settings with different resources, student demographics, and simulation infrastructure. Second, the quasi-experimental design, while appropriate given the constraints of the educational context, precludes causal inference with the same confidence as a true randomized controlled trial. Third, the self-report component of the CCAT, while supported by validity and reliability data, may be subject to social desirability bias. Finally, long-term follow-up data on clinical performance during subsequent clinical placements were not collected, leaving the durability of simulation-induced competency gains unexamined. Future research should address these limitations through multi-site designs, randomization where feasible, and longitudinal outcome tracking.

CONCLUSION

Clinical simulation-based learning is significantly more effective than conventional instructional methods in improving clinical competency among nursing professional education students, with large and clinically meaningful effects observed across all four competency domains. The implementation of structured, high-fidelity simulation programs within Ners curricula is strongly recommended as a strategic approach to enhance graduate competency, support national nursing examination success, and ultimately improve the quality and safety of nursing care delivered in Indonesian healthcare settings.

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