

## Evaluation of the Effectiveness of Simulation-Based Teaching on Nursing Education: A Systematic Review

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### Abstract

**Background:** Simulation-based training has gained popularity in nursing education as a safe and effective method for improving students' clinical skills. **Aims:** This study aims to conduct a systematic review of the available literature to evaluate the effectiveness of simulation-based teaching in nursing education. **Methods:** A systematic review of the literature was conducted using electronic databases, including Web of Science, PubMed, CINAHL, MEDLINE, Scopus, and Cochrane Library. The search strategy included keywords such as "simulation-based teaching," "nursing," and "learning." The review included 15 studies conducted in various settings that were published between 2010 and 2023. The inclusion criteria for researched literature focused on simulation-based teaching, and the exclusion criteria included studies that did not involve nursing students as participants. **Results:** Simulation-based teaching was found to be effective in enhancing nursing students' clinical skills, knowledge, and reasoning abilities, as well as improving clinical decision-making and patient outcomes. **Conclusion:** The systematic review indicates that simulation-based teaching is effective in nursing education. However, there are still concerns about the optimal implementation and cost-effectiveness of simulation-based training. Additional research is needed to identify the most effective approaches and evaluate their efficacy in diverse settings. **Recommendations:** The study recommends further exploration and evaluation of optimal implementation and cost-effectiveness of simulation-based training in nursing education. Future research should identify effective approaches and assess their efficacy in diverse settings.

**Keywords:** Simulation-Based Teaching, Nursing, Learning, Review Article.

### Introduction:

The use of simulation-based training has grown in popularity over time approach to nursing education in recent years (Cant et al., 2017; Davies et al., 2021). This method of training offers a secure and regulated setting where nursing students can hone their skills and gain valuable experience before entering the clinical setting.

Through simulation-based training, learners can acquire knowledge and skills from their mistakes and receive immediate feedback from instructors, which can help improve their confidence and competence in providing patient care (Zottmann., 2018). Simulation-based training has gained increased attention in nursing education as a valuable tool that can aid

in the acquisition of clinical and the ability to think critically. Simulation based training within the context of teaching nursing involves the use of mannequins, virtual reality, standardized patients, and other simulation equipment to create an authentic clinical environment this technique enables students to practice and enhance their abilities in a realistic clinical setting (Sterner et al., 2023). This method ensures that students learn and can make mistakes without endangering patients by providing a secure and regulated environment (Lioce et al., 2015).

Numerous research studies have examined the efficacy of simulation-based training in nursing education, with a considerable number of them reporting favorable outcomes for instance, a systematic

review and meta-analysis were performed, which illustrated the positive impact of simulation-based training on the knowledge, skills, and clinical reasoning of nursing students (Orique & Phillips 2018). Moreover, a study found that simulation-based training improved patient safety by helping nursing students develop clinical judgment skills (Labrague, 2021). Another study found that simulation-based training was more effective than traditional methods of clinical training in improving nursing students' clinical competence and confidence (Asegid & Assefa, 2021).

Simulation-based training has demonstrated its effectiveness in enhancing clinical decision-making and patient outcomes (Hung et al., 2021). Simulation-based training improved nursing students' clinical decision-making capabilities and facilitated the application of theoretical knowledge in practical clinical settings (Awang-Harun et al., 2022). However, a study has shown that simulation-based training has the potential to be cost-effective in the long run, as it reduces medical errors, improves patient outcomes, and improves nursing students' readiness for clinical practice (Awang-Harun et al., 2022).

Simulation-based training led to better patient outcomes by lowering the incidence of procedural complications during central venous catheter insertion, despite a growing body of research that backs the effectiveness of simulation-based training in nursing education, there are still questions about its optimal implementation and effectiveness in diverse populations. One area that requires further investigation is the integration of simulation-based training in nursing curricula and its evaluation for effectiveness. Additionally, it is necessary to explore how simulation-based training can effectively benefit diverse populations, such as students who are not native English speakers or who come from diverse cultural backgrounds (Kim et al., 2016).

Furthermore, there are concerns about the cost-effectiveness regarding the use of simulation-based training, can be expensive to implement, and there is a need to evaluate its cost-effectiveness compared to traditional clinical training methods (Leighton et al.,

2015). Despite the growing body of evidence supporting its effectiveness, there is still a need to study its optimal implementation and effectiveness in diverse populations. Simulation-based training can be cost-effective in the long run, and it has the potential to improve patient outcomes and reduce medical errors (Kardong-Edgren et al., 2010; Heinz et al., 2010). Therefore, the objective of this study is to assess the effectiveness of simulation-based training in nursing education.

### Significance of the study

The significance of this study lies in its evaluation of the effectiveness of simulation-based teaching in nursing education. By conducting a systematic review of the literature, this study provides valuable insights into the impact of simulation-based training on nursing students' clinical skills, knowledge, reasoning abilities, clinical decision-making, and patient outcomes. The findings of this study can inform educators, curriculum developers, and policymakers in nursing education to make informed decisions regarding the implementation and integration of simulation-based teaching methods (Koukourikos, 2021).

### Research question

What is the effectiveness of simulation-based teaching in nursing education in enhancing students' clinical skills, knowledge, reasoning abilities, clinical decision-making, and patient outcomes?

### Aim of this study

The aim of this study is to conduct a systematic review of the available literature to evaluate the effectiveness of simulation-based teaching in nursing education.

### Sub-objectives for the study:

- To contribute to the evidence, base for the integration of simulation-based teaching in nursing education programs.
- To assess the impact of simulation-based teaching on clinical skills development in nursing education.

- To examine the effect of simulation-based teaching on the critical thinking abilities of nursing students.

- To determine the influence of simulation-based teaching on the confidence levels of nursing students.

### Study hypotheses

1. What is the effect of simulation-based teaching on students' knowledge & clinical skills?

2. What is the effect of simulation-based teaching on patient outcomes as perceived by nursing students?

3. What is the effect of simulation-based teaching on students learning outcomes?

### Operational definitions

**Simulation-Based Teaching:** Refers to the use of simulated scenarios, models, or virtual environments to provide nursing education and training. It involves the replication or representation of real-life clinical situations, allowing students to actively participate, make decisions, and practice their skills in a safe and controlled environment.

**Effectiveness:** It encompasses the impact and benefits of simulation-based teaching on various aspects, including knowledge acquisition, clinical skills development, critical thinking abilities, and confidence levels of nursing students.

**Nursing Education:** Nursing education encompasses the formal learning and training programs designed to prepare individuals for a career in nursing. It includes various educational settings, such as undergraduate nursing programs

### Subjects & Methods:

#### Keywords and Search Strategy:

The search strategy for this systematic review involved identifying relevant studies through electronic databases such as PubMed, Web of Science, CINAHL, MEDLINE, Cochrane Library, and Scopus. A combination of keywords related to simulation-based training, nursing education, and effectiveness was used to retrieve relevant articles. The search strategy aimed to capture a comprehensive range of studies related to the effectiveness of simulation-based teaching in nursing education.

### Data Sources:

The data sources for this systematic review included electronic databases such as PubMed, Web of Science, CINAHL, MEDLINE, Cochrane Library, and Scopus. These databases were selected due to their extensive coverage of healthcare literature, including nursing education research. By searching multiple databases, a wide range of relevant studies were identified to address the research question.

### Eligibility Criteria:

The eligibility criteria for study inclusion in this systematic review were as follows: (1) studies published in the English language; (2) studies conducted in a nursing education setting; (3) studies evaluating the effectiveness of simulation-based training; and (4) studies including outcomes related to nursing students' knowledge, skills, clinical reasoning abilities, clinical decision-making, and patient outcomes. These criteria were established to ensure that the selected studies were directly relevant to the research question and the focus of the systematic review.

### Inclusion and Exclusion Criteria:

During the study selection process, inclusion and exclusion criteria were applied to the identified articles. Inclusion criteria included studies that evaluated the effectiveness of simulation-based teaching in nursing education and reported relevant outcomes. Exclusion criteria involved excluding studies that did not meet the inclusion criteria, such as studies not evaluating the effectiveness of simulation-based teaching or those not involving nursing students as participants. The application of these criteria aimed to ensure the selection of studies that were most relevant to the research question and met the predefined objectives of the systematic review.

### Data Extraction:

Data extraction involved systematically collecting relevant information from the included studies. The extracted data typically included study characteristics (e.g., study design, sample size), intervention details (e.g., description of simulation-based teaching approach), outcome measures, and study results.

**Bias Assessment:**

In this study, the risk of bias was evaluated using the risk of bias assessment tool known as PROBAST Wolff et al., (2019). The assigned authors, “ES, AO, and EA”, who were responsible for data extraction, assessed the risk of bias in their respective assigned studies. The evaluations of the overall study were reviewed and verified by authors “AJ and HB”. The evaluation process focused on four key areas: analysis, outcome, predictors, and participants.

**Study Selection:**

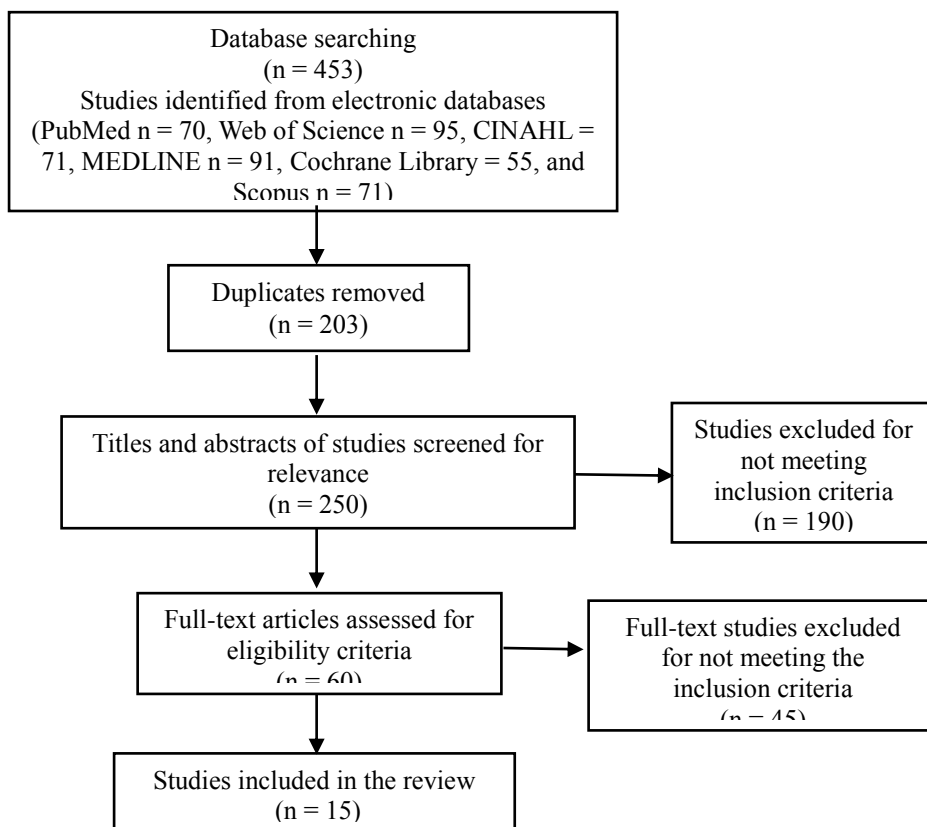
The study selection process involved a systematic screening of the identified articles based on the inclusion and exclusion criteria. Initially, the articles were screened based on their titles and abstracts to determine their potential relevance. Subsequently, full-text articles were reviewed to assess their eligibility for inclusion in the systematic review, figure 1 shows a flowchart of the process of study selection.

**Data Synthesis**

The included studies were analyzed and synthesized to evaluate the effectiveness of simulation-based teaching in nursing education. The findings were presented, strengths and limitations were discussed, and recommendations were provided. The data synthesis aimed to provide a comprehensive overview and draw meaningful conclusions regarding simulation-based teaching in nursing education.

**Statistics**

In this systematic review, statistical analysis was conducted to synthesize the findings from the included studies. The heterogeneity assessment was used to determine the appropriateness of combining the data, statistical methods were employed to derive pooled effect estimates and assess the overall effectiveness of simulation-based teaching in nursing education.



**Figure 1: The flowchart shows the process of study selection**

## Results

**Table (1)** summarizes correlations between study results and the evaluation of simulation-based teaching effectiveness in nursing education by **Cant et al., (2017)**, reviewed 25 studies, showing simulation's positive impact on knowledge, psychomotor development, self-efficacy, and critical thinking through standardized patient simulation. **Davies et al., (2021)**, evaluated intermediate-fidelity simulation training with 99 participants, improving clinical skills, stress perceptions, and confidence in healthcare education. **Zottmann et al., (2018)**, assessed Crisis Resource Management skills in full-scale simulator training with 34 participants, providing valuable insights. **Sterner et al., (2023)**, conducted a quasi-experimental study with 61 participants, showcasing the positive influence of blended simulation activities on critical thinking skills. **Oriq & Phillips., (2018)**, performed a meta-analysis of 19 studies, comprehensively understanding simulation's effectiveness in enhancing knowledge and skills. **Labrague, (2021)**, reviewed 10 studies, highlighting broader benefits like improved delegation, teamwork, decision-making, and problem-solving skills. **Asegid & Assefa, (2021)**, analyzed 24 studies on high-fidelity and virtual simulator training, yielding insights into their effectiveness in enhancing skill performance. These studies provide evidence of simulation-based teaching's positive impact on healthcare education, encompassing knowledge, skills, confidence, critical thinking, and clinical performance outcomes.

**Table (2)** shows the main points of the given scenarios are as follows: Medication administration scenario: Students engage in a simulated patient scenario where they practice administering medication and monitoring the patient's response. Patient assessment scenario: Students participate in a simulated patient scenario where they conduct a comprehensive patient assessment and develop an appropriate care plan. Code blue scenario: Students are presented with a simulated patient scenario involving a code blue emergency, requiring them to respond promptly and provide life-saving interventions. Cultural competence scenario: Students experience a simulated patient scenario that highlights the importance of cultural competence. They must demonstrate skills such as effective communication and respect for diversity. These scenarios provide opportunities for nursing students to apply their knowledge and skills in realistic, simulated situations, enhancing their learning and preparing them for real-world healthcare challenges.

**Table (3)** shows the article reviews the suggested guidelines for simulation-based training in nursing education, as specified by the National Council of State Boards of Nursing (NCSBN), in 2015. The table presents six recommendations, each with a brief description of what should be done to implement the recommendation effectively. These recommendations include integrating simulation-based training into the curriculum, using realistic scenarios, providing faculty with adequate training, using a structured debriefing process, and evaluating the effectiveness of simulation-based training.

Table (1): Characteristics of studies included in the study

| Study                      | Sample Size or No of Studies | Study Design                        | Type of Simulation                                    | Outcome Measures   |
|----------------------------|------------------------------|-------------------------------------|---|--|
| Cant & Cooper, (2017)      | (25 studies)                 | Systematic Review                   | Standardized patient simulation                       | knowledge, psychomotor development, self-efficacy, and critical thinking   |
| Davies et al., (2021)      | 99                           | Pretest/post-test                   | Intermediate-fidelity simulation training technology  | Clinical skills, perceptions of stress, and confidence                     |
| Zottmann et al., (2018)    | 34                           | Control group design                | Full-scale simulator                                  | Skills related to Crisis Resource Management                               |
| Sterner et al., (2023)     | 61                           | Quasi-experimental                  | Blended simulation activities                         | Critical thinking skills   |
| Orique & Phillips., (2018) | (19 studies)                 | Meta-analysis                       | Simulation-based interventions as a teaching modality | Knowledge and skills performance   |
| Labrague, (2021)           | (10 studies)                 | Integrative review                  | Simulation as a teaching modality                     | Improved delegation, teamwork, decision-making, and problem-solving skills |
| Asegid & Assefa, (2021)    | 2209 (24 studies)            | Systematic review and meta-analysis | High fidelity simulator, virtual simulator            | Improve skill performance among the intervention groups                    |
| Hung et al., (2021)        | 79                           | Experimental                        | Simulation scenarios                                  | Nursing competence, self-efficacy, and learning satisfaction scores        |
| Awang-Harun et al., (2022) | 19                           | Kirkpatrick Model                   | Simulation as part of the multimodal pedagogy         | Improved overall post-test theoretical and clinical assessment performance |
| Kim et al., (2016)         | 40 Studies                   | Meta-analysis                       | Hybrid simulations                                    | Cognitive, affective, and psychomotor domains.                             |
| Leighton et al., (2015)    | 1,288                        | Exploratory factor analysis         | Simulation as a teaching modality                     | Effectiveness of learning in the simulation environment.                   |
| Jallad and Işık, (2022)    | 1797 (23 studies)            | Systematic Review                   | Virtual reality simulation                            | Clinical skills, knowledge, self-confidence, and self-efficacy.            |
| Theobald et al., (2021)    | 1532 (10 studies)            | Systematic Review                   | Clinical simulations mimic real-life scenarios.       | Simulation's effectiveness for clinical reasoning acquisition.             |
| Alshehri et al., (2023)    | (15 studies)                 | Systematic Review                   | High-fidelity simulation                              | Clinical skills in reasoning, thinking, solving, and deciding.             |
| Ayed et al., (2022)        | 150                          | Quasi-experimental                  | High-fidelity simulation                              | Clinical judgment assessed with a rubric tool.                             |

Table (2): Examples of simulation-based training scenarios

| Scenario                  | Description   |
|---------------------------|---|
| Medication administration | Students are presented with a simulated patient scenario in which they must administer medication and monitor the patient's response.                                   |
| Patient assessment        | Students are presented with a simulated patient scenario in which they must perform a comprehensive patient assessment and develop a care plan.                         |
| Code blue                 | Students are presented with a simulated patient scenario in which they must respond to a code blue emergency and provide life-saving interventions.                     |
| Cultural competence       | Students are presented with a simulated patient scenario that requires them to demonstrate cultural competence skills, such as communication and respect for diversity. |

Table (3): Optimal strategies for simulation-based training in nursing education

| Recommendation   | Description   |
|--|---|
| Incorporate simulation-based training as a part of the nursing curriculum. | To guarantee that students receive sufficient training, it is advisable, to integrate simulation-based training as a component of the nursing curriculum.                                     |
| Use realistic scenarios  | Simulation-based training should use realistic scenarios to ensure that students are prepared for real-world clinical situations.   |
| Provide adequate training for faculty                                      | Faculty who teach simulation-based training should receive adequate training to ensure that they are prepared to teach and evaluate students in this context.                                 |
| Use a structured debriefing process  | The debriefing process should be structured and focused on enhancing the development of clinical judgment abilities to ensure that students can make informed decisions in clinical settings. |
| Focus on the development of clinical judgment skills                       | Simulation based training should Prioritize the cultivation of clinical judgment abilities to ensure that students can make informed decisions in clinical settings.                          |
| Assess the efficacy of simulation-based training.                          | It is important to assess the efficacy of simulation-based training to ensure that it is fulfilling the educational requirements of nursing students.   |

## Discussion

The findings of these studies contribute to the evaluation of the effectiveness of simulation-based teaching in various ways, the results of the review referred that simulation-based training is an effective approach to nursing education. The study included in the review consistently showed that simulation-based training improved nursing students' knowledge, skills, and clinical reasoning abilities. This result is consistent with a study conducted by **Koukourikos et al., (2021)**, the results indicated that the application of simulation for students supports clinical skill development.

Studies have demonstrated that simulation-based training has the potential to improve clinical decision-making and result in improved patient outcomes and helped apply theoretical knowledge to clinical practice, these results are supported by the findings of a study

that improved clinical decision-making conducted by **Lioce et al., (2015)**. The study demonstrates the effectiveness of full-scale simulator training in developing skills related to Crisis Resource Management through a control group design, a similar study its results indicate an improvement in collective orientation after training study by **Flentje et al., (2020)**

The results show an assessment of the effectiveness of blended simulation activities in improving critical thinking skills, offering valuable information on the outcomes of this teaching approach. This finding was supported by a study the results show evidence referring that simulation-based training as an effective approach for enhancing nursing students' knowledge, skills, and clinical reasoning abilities study by **Orique & Phillips, (2018)**. One of the review studies integrative review highlights the positive impact of simulation on delegation, teamwork, decision-making, and problem-solving skills, providing evidence of

its effectiveness in these areas. This result is supported by a study conducted by **Kardong-Edgren et al., (2021)**, about positive impact of simulation tools evaluations.

The results highlight the effects of simulation scenarios on nursing competence, self-efficacy, and learning satisfaction scores, providing evidence of the effectiveness of simulation in enhancing these outcomes, additionally, it examines the integration of simulation as part of a multimodal pedagogy and measures overall post-test theoretical and clinical assessment performance, this contributes to our understanding of the effectiveness of this instructional approach. This result is consistent with studies that support their findings, providing evidence of the effectiveness of simulation in education by **Rizzolo et al., (2015)** and **Motola et al., (2013)**. In terms of the cognitive domain, a study by **Kim et al., (2016)**, examined the effects of simulation on knowledge acquisition and retention. The study found that participants who underwent simulation training showed significant improvements in their knowledge and understanding of complex medical concepts compared to traditional instructional methods. The simulation allowed learners to actively engage in realistic scenarios, promoting critical thinking, problem-solving, and decision-making skills.

Regarding the affective domain their study conducted by **Jallad and Işık (2022)**, explored the impact of simulation on learners' attitudes, confidence, and empathy. The results revealed that simulation training increased learners' confidence levels, especially when faced with challenging patient scenarios. Moreover, participants reported a greater sense of empathy and understanding toward patients after experiencing realistic simulation encounters. This suggests that simulation can foster positive attitudes and emotional engagement, enhancing the affective aspects of learning.

In terms of the psychomotor domain, a study by **Cant & Cooper, (2017)**, investigated the effects of simulation on the development of procedural skills. The findings demonstrated that simulation-based training significantly

improved participants' technical skills and proficiency in performing specific clinical procedures. Learners had the opportunity to practice and refine their psychomotor skills in a safe and controlled environment, leading to increased competence and confidence in real-life clinical settings.

The effects of simulation on clinical behaviors and patient outcomes are important factors. Study conducted by **Yun et al., (2023)**, investigated the effects of simulation training on clinical behaviors in nursing students. The findings revealed that participants who underwent simulation training demonstrated improved clinical skills, such as accurate assessment and effective communication with patients. These enhanced clinical behaviors positively influenced patient outcomes, including reduced medication errors and increased patient satisfaction. Another study by **Everson et al., (2020)**, focused on the impact of simulation-based training on patient outcomes in emergency medicine. The results indicated that healthcare providers who received simulation training showed improved decision-making abilities, leading to more timely and appropriate interventions. Consequently, patient outcomes, such as reduced mortality rates and improved treatment outcomes, were observed in the simulation-trained group compared to traditional training methods.

There are a few significant limitations to our study that should be mentioned. Generalizability: The studies included in the review may have been conducted in specific settings, with certain populations or educational contexts. Publication bias: The review may be susceptible to publication bias, as studies with positive results are more likely to be published than those with negative or inconclusive findings. There need for further research to address these limitations and provide a more comprehensive understanding of the effectiveness of simulation-based teaching in nursing education.

## Conclusions

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The systematic review evaluating the effectiveness of simulation-based teaching in nursing provides valuable insights into the



impact of this educational approach. The review findings consistently support the effectiveness of simulation-based training in various aspects of nursing education. The studies included in the review consistently demonstrated that simulation-based training improved nursing students' knowledge, skills, clinical reasoning abilities, and clinical decision-making, and effects on clinical behaviors and patient outcomes. Simulation-based training has shown promise in enhancing cognitive, affective, and psychomotor domains of learning.

### Recommendations:

1. Further research: Conduct additional studies to investigate the optimal implementation and cost-effectiveness of simulation-based training in nursing education.

2. Standardization: Develop standardized guidelines and protocols for simulation-based teaching in nursing education.

3. Multidimensional assessment: Utilize a comprehensive range of assessment tools to evaluate the impact of simulation-based teaching on nursing students' clinical skills, knowledge, reasoning abilities, clinical decision-making, and patient outcomes.

4. Collaboration and resource sharing: Encourage collaboration among educational institutions, healthcare facilities, and simulation centers to share resources, expertise, and best practices in simulation-based teaching.

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