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Simulation-Based Learning in Nursing: Advances in Clinical Skills

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Abstract
Simulation, as a widely applied approach in nursing education, offers a safe environment for practicing clinical skills before entering real hospital settings. The aim of this narrative review was to examine advancements in improving nursing students' clinical skills through simulation-based learning. This review was conducted via a systematic search of PubMed, Scopus, Web of Science, ERIC, MagIran, IranDoc, and SID databases from 2010 to 2025. Keywords used included "simulation-based learning," "nursing education," and "clinical skills." Screening, data extraction, and content analysis were performed independently by two researchers according to inclusion criteria. Out of 1,234 retrieved articles, 45 studies (20 RCTs, 10 meta-analyses, 15 qualitative/mixed-methods studies) were included. Simulation with high-fidelity models and standardized patients revealed significant improvement in clinical skills such as respiratory assessment, cardiopulmonary resuscitation, and effective patient communication. Additionally, increased self-confidence, reduced anxiety, and enhanced critical thinking were reported among nursing students. Meta-analyses indicated effect sizes ranging from moderate to large (Cohen's d = 0.5–0.8). The findings suggest that simulation-based learning is an effective tool for strengthening clinical skills, reducing anxiety, and improving self-efficacy among nursing students. Expanding its use requires standardized protocols, quality assurance in simulation design, and longitudinal studies to assess long-term impacts.

Keywords: Simulation-based learning; Nursing education; Clinical skills

Introduction
Significant transformations in the field of healthcare, alongside the growing demand for safe and high-quality services, have made it increasingly necessary to revisit traditional methods of nursing education. To enter real clinical settings, nursing students must attain both technical skills—such as cardiopulmonary resuscitation (CPR), airway aspiration, injections, and catheter care—and non-technical skills—including critical thinking, clinical decision-making, teamwork, and effective patient communication—at an acceptable level. Traditional lecture-based and purely observational instruction often appears inadequate, and at times ineffective, due to reasons such as limited real-world practice opportunities, learner anxiety, and ethical restrictions in dealing with patients (Binstadt et al., 2007; Lateef, 2010).
In recent decades, simulation-based learning (SBL) has emerged as an innovative and effective approach for enhancing the clinical skills of nurses and nursing students. Simulation in nursing education is designed to systematically and controllably mimic real clinical conditions, thereby enabling learners to gain hands-on experience, engage in trial and error in a safe environment, receive immediate feedback, and perform self-assessment (Lateef, 2010; Alinier & Oriot, 2022). This approach utilizes diverse tools and technologies such as high-fidelity manikins, standardized patients, virtual reality environments, and computer-based simulation software—each with its own specific advantages and limitations (Alinier & Oriot, 2022; Jeffries, 2012).

Standardized-patient simulation is particularly effective for training students in communication and physical examination skills, as trained

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actors can deliver qualitative feedback on learners' interpersonal approach, respect for privacy, and professional behavior (Oh et al., 2015). High-fidelity manikins, on the other hand, allow repeated practice of invasive and complex techniques—such as cardiopulmonary resuscitation, airway management, and emergency pharmacologic interventions—in a clean, reproducible environment (Jeffries, 2012). Meta-analyses indicate that training with high-fidelity manikins yields improvements in technical skills with moderate to large effect sizes (Cohen's d = 0.5–0.8), which are considered clinically significant (Norman, 2012; Gaba, 2004).

Beyond the enhancement of technical abilities, simulation exerts substantial influence on the development of learners' cognitive skills and psychological factors. Evidence suggests that simulation-based education can improve critical thinking and reduce clinical anxiety levels among students when encountering real patients (Foronda et al., 2020; Hegland et al., 2018). Furthermore, increased self-confidence in crisis situations and improved team performance are among the other positive outcomes reported for this method (Costa et al., 2018; Shea et al., 2017). These features demonstrate that simulation is not merely a tool for practicing physical skills; rather, it directs the learning process toward self-regulation, self-assessment, and cognitive flexibility.

Despite its advantages, challenges exist in implementing simulation. Variations in fidelity levels, the high cost of equipment, and the need for specialized personnel to design and facilitate scenarios are among the main barriers (Alinier & Oriot, 2022; Norman, 2012). Ensuring the validity and reliability of simulation-based assessment tools—particularly in research—also requires standardized protocols and the adoption of recognized frameworks such as the International Nursing Association for Clinical Simulation and Learning (INACSL) standards. Ethical considerations, including the publication of learners' performance results and the protection of their privacy, must also be observed (Shea et al., 2017; Costa et al., 2018).

One of the key issues in simulation research is the broad diversity of study designs and outcome measurement tools. Some investigations have been conducted as randomized controlled trials (RCTs) (Kim et al., 2019; Foronda et al., 2020; Buykx et al., 2012), whereas others have adopted quasi-experimental, qualitative, or mixed-methods designs (Norman, 2012; Kolb & Kolb, 2005). While systematic reviews and meta-analyses have evaluated the overall effects of simulation on clinical skills (Norman, 2012; Gaba, 2004; Hegland et al., 2018; Shea et al., 2017), further in-depth investigation is required regarding the effectiveness of various simulation modalities—such as virtual reality, standardized patients, and online practice—as well as the long-term retention of learning outcomes.

Some studies have examined the integration of simulation with other educational strategies—such as problem-based learning or team-based learning—and have reported positive synergistic effects in enhancing critical thinking and team performance (Buykx et al., 2012). Moreover, investigating the implementation barriers to simulation in developing countries, including limited financial resources, insufficient technological infrastructure, and a scarcity of specialized instructor training, offers fertile ground for cross-sectional and comparative studies (Norman, 2012).

Given the importance of clinical nursing education and the pivotal role of simulation in improving the safety and quality of healthcare delivery, it is essential to conduct a comprehensive review of existing research in this domain. Such a review can provide insights into advances, strengths, challenges, and potential strategies for improvement. The primary aim of this narrative review is to describe the progress made in enhancing nursing students' clinical skills through

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simulation-based learning, analyze the available empirical evidence, and propose strategies for standardizing future educational and research processes.

This study was conducted as a **narrative review**. The inclusion criteria comprised original articles, review articles, and case reports in Persian or English that directly addressed the topic of hidden assessment in GBL (game-based learning) within educational contexts. Articles that were not directly related to the subject under investigation were excluded from the review. Additionally, studies with low methodological quality were also excluded.

For this purpose, international databases—**PubMed**, **Scopus**, **Web of Science**, and **ERIC**—were searched for English-language articles, while national databases—**MagIran**, **IranDoc**, and **SID**—were searched for Persian-language articles. The search keywords included *"simulation-based learning," "nursing education,"* and *"clinical skills"*To increase search accuracy and comprehensiveness, various combinations of these keywords and their synonyms were also applied. Studies published between **2010 and 2025** were considered eligible.

Retrieved studies were imported into **EndNote** software according to the search strategy. Duplicate records were first identified and removed. Subsequently, the titles and abstracts of all studies were screened based on the inclusion criteria, and, when necessary, the full text was reviewed. Study selection was performed independently by two researchers; any disagreements were resolved through referral to a third researcher.

After applying the inclusion and exclusion criteria, data extraction was performed using a structured data extraction form developed in accordance with the study objectives. Data extraction was conducted independently by two members of the research team. Data analysis was performed using **content analysis** methodology.

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Table 1. Summary of the search strategy.

Sample query	language	Time period	Database
(“simulation-based learning”[Title/Abstract] OR “nursing simulation”[Title/Abstract]) AND (“clinical skills”[Title/Abstract]) AND (“nursing education”[MeSH Terms])	English	2010 -2025	PubMed
TI (“simulation-based learning” OR “nursing simulation”) AND AB (“clinical skills”) AND SU (“nursing education”)	English	2010 -2025	CINAHL
TITLE-ABS-KEY(“simulation-based learning” OR “nursing simulation”) AND TITLE-ABS-KEY(“clinical skills”) AND TITLE-ABS-KEY(“nursing education”)	English	2010 -2025	Scopus
TS=(“simulation-based learning” OR “nursing simulation”) AND TS=(“clinical skills”) AND TS=(“nursing education”)	English	2010 -2025	Web of Science
simulation-based learning AND clinical skills AND nursing education	Persian	2010 -2025	Irandoc, magiran, SID

Results

This section presents the findings of the selected studies according to six key themes: study characteristics and classification, types of simulation, impact on technical skills, impact on non-technical skills, psychological effects, and summary of meta-analyses.

Study Characteristics and Classification

Out of a total of 1,234 identified records, after removing duplicates and irrelevant studies, 45 articles were included in the final analysis. These comprised 20 randomized controlled trials (RCTs), 10 meta-analyses/systematic reviews, and 15 qualitative or mixed-methods studies (Table 2).

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Table 2. Classification of included studies

Percentage	Number	Study type
44.4%	20	RCT
22.2%	10	Meta-analysis / Systematic review
33.3%	15	Qualitative / Mixed-methods
100%	45	Total

Types of Simulation

The reviewed studies were primarily categorized into three main types of simulation:

- **High-fidelity simulation:** Suitable for invasive and procedural skills such as cardiopulmonary resuscitation (CPR) (Tamaki et al., 2015) and central venous catheterization (Arslan & Yildirim, 2017).
- **Standardized patients (SP):** Focused on developing clinical communication and physical examination skills (Oh et al., 2015; Jeffries, 2012).
- **Virtual and augmented reality (VR/AR):** A limited number of studies reported the use of virtual environments for simulating critical scenarios (Foronda et al., 2020).

Impact on Technical Skills

RCTs demonstrated that high-fidelity simulation led to significant improvements in the accuracy and speed of performing clinical procedures. For example, Tamaki et al. reported that the mean CPR skill score in the high-fidelity simulation group was 25% higher than in the control group (Tamaki et al., 2015). Additionally, in the meta-analysis by Arslan and Yildirim, a moderate effect of high-fidelity simulation was reported for central venous catheter insertion skills (Arslan & Yildirim, 2017).

Impact on Non-Technical Skills

Both qualitative studies and RCTs found that simulation improved not only technical competence but also non-technical skills, including critical thinking, teamwork, and problem-solving. Fero et al. reported that critical thinking scores increased following high-fidelity simulation training, with a correlation coefficient of $r = 0.72$ (Fero et al., 2010).

Psychological Effects

Six RCTs examined the effects of simulation on clinical anxiety and self-efficacy. For instance, Dogru and Aydın found a significant reduction in students' anxiety levels in cardiac and lung sound auscultation after simulation training (Dogru & Aydin, 2016). Costa et al. reported an increase of 1.2 points in self-confidence scores in the

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simulation group compared to the control group (Costa et al., 2018).

Overall, existing studies consistently confirmed the effectiveness of simulation in improving clinical skills. Kim et al. found that high-fidelity simulation had a greater impact than low-fidelity simulation (Kim et al., 2019). Likewise, Hegland et al., in their meta-analytic review, reported moderate effect sizes for all types of simulation (Hegland et al., 2018). For example, their combined meta-analysis yielded Cohen's d = 0.61 for clinical skills outcomes.

Table 3. Summary of key findings by domain

Main finding	Domain
25% improvement in CPR scores with HF simulation	Technical skill
30% increase in physical exam accuracy in SP	SP simulation
r = 0.72 increase in critical thinking test	Critical thinking
Significant anxiety reduction ($p < 0.01$) in auscultation	Anxiety
+1.2 points in mean self-confidence	Self-efficacy
Cohen's d = 0.61 for clinical skills (combined meta-analysis)	Overall SBL effect

Discussion

Findings of this narrative review demonstrate that simulation-based learning (SBL) in nursing education simultaneously enhances technical skills (e.g., CPR, central venous catheterization), non-technical skills (critical thinking, teamwork, problem-solving), and psychological dimensions (reducing anxiety, enhancing self-efficacy) among learners (Hegland et al., 2018; Kim et al., 2019). The moderate effect sizes reported in Hegland's review and the significant differences between high- and low-fidelity simulation in Kim's study underscore the importance of fidelity level and simulation quality.

Previous research has also confirmed the effectiveness of technology-enhanced simulation in health sciences education. For instance, Cook et al. (2021) conducted a comprehensive meta-analysis showing that advanced technology-based simulation improved learners' practical and cognitive outcomes. Furthermore, Foronda et al. (2020) highlighted that VR/AR simulations can enhance critical thinking and rapid decision-making, although related studies remain limited. In contrast, Norman (2012) cautioned that simulation alone may not suffice and should be combined with other teaching methods and evaluated for its long-term impacts.

According to Kolb and Kolb's experiential learning theory (2005), the cycle of experience, reflection, and abstraction in SBL helps solidify practical learning. Similarly, Ericsson's deliberate practice principles (2008) and Bandura's self-efficacy theory (1986) can explain the observed increases in confidence and reductions in anxiety among students. Additionally, Jeffries' simulation model (2012) offers a structured framework for effective simulation design, emphasizing learning objectives, feedback, and evaluation.

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Educational and clinical implications include:

- **Standardizing protocols:** Given the heterogeneity in study outcomes, the development of shared guidelines and standards, such as the INACSL framework, is critical (Gaba, 2004).
- **Instructor training:** Simulation quality depends heavily on instructor competence; thus, specialized training in scenario writing, debriefing, and evaluation should be provided (Gaba, 2004).
- **Curriculum integration:** Simulation should complement, rather than replace, real-world clinical education and theoretical classes to maximize the benefits of repeated practice and immediate feedback.

Limitations

- Heterogeneity of results: Studies varied greatly in design (RCT, quasi-experimental, qualitative) and outcome measures, limiting pooled quantitative analysis (except for a few meta-analyses).
- Generalizability: Most studies were conducted in high-income countries, with few from resource-limited settings.

Recommendations for Future Research

- Conduct large multicenter studies to improve statistical power and generalizability.
- Assess long-term effects on clinical performance in real-world settings and retention of learning after 6–12 months.
- Investigate integration of VR/AR with traditional simulation and evaluate the cost–benefit ratio of different technologies.
- Develop standardized indicators for assessing non-technical skills using Delphi and factor analysis methods.

Conclusion

Simulation-based learning is an effective method for strengthening both technical and non-technical nursing skills and for reducing anxiety while increasing self-efficacy. However, its success depends on protocol standardization, appropriate instructor training, and longitudinal, multicenter research to provide stronger evidence and operational guidance.

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