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The Use of High-Fidelity Simulation in Pre-Licensure Nursing Programs: A Systematic Review

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Abstract

Aim: This study aimed to evaluate the effectiveness of high-fidelity simulation in prelicensure nursing programs as it relates to the confidence, knowledge, and skills of student nurses. **Background:** Initiatives to improve the quality of prelicensure education in nursing programs include high-fidelity simulations, but research on their impact on student nurses' confidence, knowledge, and skills remains limited. Nurses' confidence in practical settings is essential for quality patient care and therapeutic use of self. **Methods:** Articles published between 2014-2025 that used experimental and quasi-experimental studies on high-fidelity simulations were searched in EBSCO host, Google Scholar, ProQuest, Medline, and Cumulative Index to Nursing and Allied Health Literature (CINAHL). **Results:** Six articles involving 402 participants who were undergraduate nursing students from various universities were included in this meta-analysis. Pooled results of the analyses showed that the effect of high-fidelity simulation on knowledge was statistically significant, a random-effects meta-analysis revealed a significant positive effect, 0.74, 95% CI [0.16, 1.31], P = 0.01, the forest plot on the impact of high-fidelity simulation on skills was statistically significant, a random-effects meta-analysis revealed a significant positive effect, 0.69, 95% CI [0.17, 1.21], P = 0.01, and based on five of the studies, the effect of high-fidelity simulation on confidence was statistically significant based on random-effects meta-analysis, 0.60, 95% CI [0.17, 1.02], P = 0.01. **Conclusions:** This review highlights the importance of high-fidelity simulation in pre-licensure nursing programs. High-fidelity simulation improves student nurses' skills, knowledge, and confidence before graduation. Confidence is an important attribute for new nurses in the ever-changing highly stressful care settings. **Relevance to Clinical Practice:** The use of high-fidelity simulations in pre-licensure nursing programs improves student nurses' skills, knowledge, and confidence, which are the essential traits for quality patient

care in practical settings. **Patient or Public Contribution:** What does this paper contribute to the wider global clinical community? 1) Improved clinical reasoning skills essential for quality patient care. 2) Practical and demonstratively effective ways to inculcate confidence and knowledge among new nurses.

Keywords

Simulation, High-Fidelity, Prelicensure Nursing Program, Experimental Study, Quasi-Experimental Design, Systematic Review

1. Introduction

Many nursing programs use high-fidelity simulation (HFS) and other instructional modes during training to prepare students for clinical practice and patient-centered quality care. With the progression of technology and science, healthcare services have become increasingly complex and stressful; technological innovations help bridge gaps and reduce challenges for nurses. Due to performance expectations, new graduates often feel unprepared to function in these complex health care settings [1]. The nursing profession today demands a high level of knowledge and skills [2]. Using standardized patients (SPs) in simulations helps to improve communication and confidence among students in a safe environment that mimics clinical situations [3]. As a lively pedagogy approach, it helps nursing students to unite and value knowledge, develop technical and interactive skills, and develop disciplines and responses for thinking and reflection, thus contributing to the training of skilled professionals [2]. Learning in a highly engaged state increases the chances of recall during a similar state, anchoring the knowledge within experiences [4]. Increasingly complex patient needs have driven various medical professionals to become more sophisticated in meeting these needs [5].

Simulation-based education helps students to develop requisite skills, develop and maintain competency, and improve performance, leading to improved efficiency in health services delivery [6]. Simulation is widely recognized in healthcare for its realism and positive impact on skill acquisition in registered nurse education [7]. A principal justification for using HFS is its realism, enabling students to apply their learning to real patients [8]. The most widely recognized benefits of simulation-based training include patient and student safety, constant feedback from multiple sources, repeatable training, and reliable achievement of learning objectives [9]. As front-line providers, nurses play a crucial role in ensuring patient safety [10]. Facilitators reported that simulation increased student engagement and critical thinking skills more than traditional teaching methods [9]. HFS provides experiential and reflective learning in a realistic practice setting to optimize knowledge and skill transfer [11]. Human patient simulators are increasingly used in nursing education, providing clinical practice opportunities that simulate

actual patient encounters [8]. Nurses with higher levels of critical thinking can better gather information to analyze, reflect on, and ultimately solve clinical problems [12]. It has been previously shown that higher-order thinking skills are improved in technologically enhanced learning environment [13]. Simulation education emphasizes provision of realistic conditions by utilizing computerized patient simulators, virtual reality, and standardized patients to help learners achieve a better level of practical capabilities [14]. HFS provides interactive skills that have enabled students to be more proactive and involved in the learning process [15]. However, research on nurses' knowledge, skills, and confidence remains limited, and a gap still exists on how self-confidence can affect clinical practice among nurses.

Objective: The purpose of the study is to evaluate the effectiveness of high-fidelity simulation in prelicensure nursing programs as it relates to the confidence, knowledge, and skills of student nurses.

Specifically, this systematic review was guided by the following research question:

Research question: Does high-fidelity simulation positively influence the confidence, knowledge, and skills of student nurses? Following the PICOT-style framework, in prelicensure nursing programs (P), does the use of high-fidelity simulation (I) compared to traditional learning methods (C) positively influence the confidence, knowledge, and skills of student nurses (O), during training (T)?

2. Methods

This review evaluated the effectiveness of high-fidelity simulation in prelicensure nursing programs as it relates to the confidence, knowledge, and skills of student nurses.

2.1. Studies

Experimental and quasi-experimental designs that have been used to evaluate the effectiveness of simulation training on nursing students' confidence, knowledge, and skills were searched for in this study. Articles published in languages other than English were excluded.

2.2. Participants

Pre-licensure students at all levels of nursing programs, including Bachelor of Science in Nursing and Entry Level Master of Science in Nursing. Nursing programs include those in the Sultanate of Oman, Jordan, Türkiye, South Korea, Kingdom of Saudi Arabia, and China.

2.3. Interventions

Experimental and quasi-experimental studies that focused on at least one of the following were included in the review: 1) nursing students' skills, 2) knowledge, and 3) confidence.

2.4. Search Strategy

To develop search strategies for the studies, PICOT framework was used [16]. The study population included prelicensure nursing programs in various universities. The intervention of interest was a high-fidelity simulation compared with traditional clinical training. The primary outcomes assessed were the confidence, knowledge, and skills of student nurses during their training. The initial search was conducted on EBSCO host, Google Scholar, ProQuest, Medline, and Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases, looking for articles up to August 2025, using string: "(prelicensure nursing programs) OR (high-fidelity simulation) OR (student nurses' confidence) OR (student nurses' knowledge) OR (student nurses' skills)". Three independent researchers (PO, JB, and SL) performed the systematic search, and the institution's Librarian (EK) provided guidelines. The search results were independently reviewed to determine inclusion. Titles and abstracts were reviewed, and if eligibility was uncertain, the full text was screened. A manual search of the reference lists was also performed on all screened articles using Joana Briggs Institute (JBI) critical appraisal tool [17]. The study was approved by the University's Institutional Review Board (IRB2024-207).

3. Criteria for Selecting Studies

The inclusion and exclusion criteria followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA), as shown in **Figure 1**.

3.1. Inclusion and Exclusion Criteria

The inclusion criteria were articles that examined best practices in HFS-based healthcare education, focused on pre-licensure nursing programs, were peer-reviewed and published between 2014 and 2025, and used either experimental or quasi-experimental designs. Duplicate articles, inaccessible full texts, case reports, mixed-methods studies, case reviews, studies published before 2014, studies focusing on post-licensure nursing programs, or studies using qualitative research methods were excluded from the review.

3.2. Assessment of Study Quality

Two authors (PO and SL) independently selected studies that met the eligibility criteria. Three authors (SL., JB., and PO.) checked each text completely using the Joanna Briggs Institute (JBI) critical appraisal checklist in the final process [17]. Each statement offered four response options: Yes, No, Not Applicable, and Unclear. A "Yes" response was assigned a score of 1, while all other options received a score of 0. Following the evaluation, studies with a JBI score below 70% were excluded. Subsequently, the authors reviewed the selection outcomes to identify any discrepancies. Ultimately, all authors discussed again to reach a unanimous agreement, with no conflicting opinions regarding the suitability of the included studies. **Figure 1** shows the PRISMA 2021 [18] flow diagram. From the 1767 records

identified, 632 remained after duplicate, non-primary research, and articles not focused on nursing students were removed. After they were screened by title and abstract, 240 records were excluded as not relevant. Among the 392 articles sought for retrieval, 130 were not retrieved. Of the 262 full-text articles that met criteria, 256 were excluded due to JBI below 70%, belonged to case reports, belonged to case reviews, had a wrong study design, and had a high risk of bias. Six studies with low to moderate risk were included in the review.

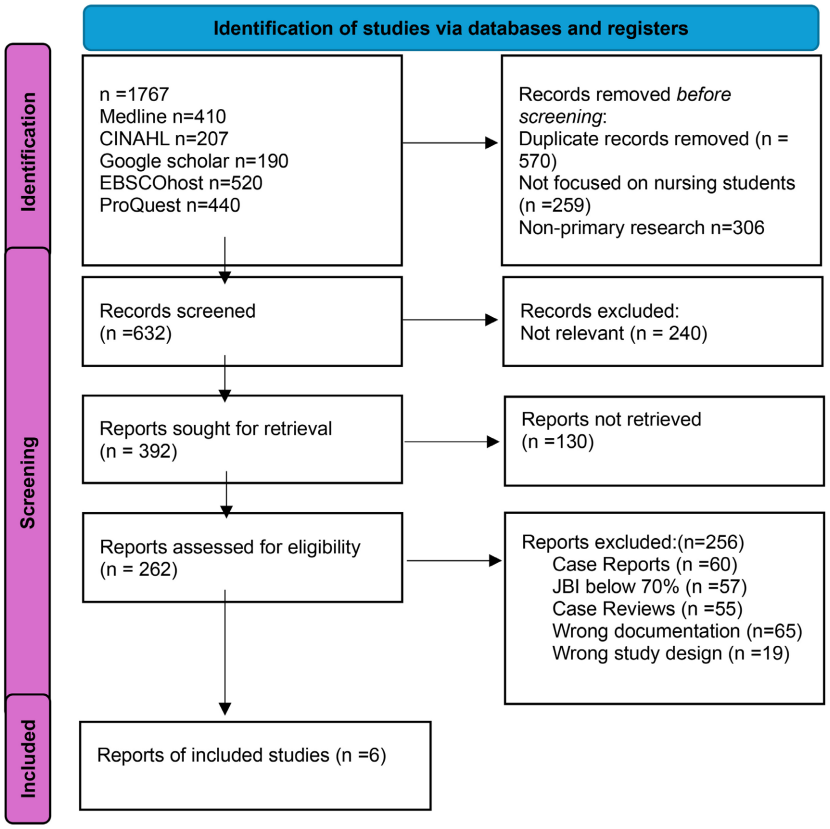

Figure 1. Flow chart of the study selection process.

To inform the appropriateness of including studies in the meta-analysis and facilitate assessment of the strength of the evidence we assessed the risk of bias in each included study using the Cochrane Collaboration's Risk of Bias tool [19] [20]. Three reviewers (PO, JB, and SL) completed this independently and agreed on final assessments. ROBINS-I tool for non-randomized studies [21] consists of 7 domains: Bias due to confounding, bias in the selection of participants into the study, bias in classification of interventions, bias due to deviations from intended interventions, bias due to missing data, bias in measurement of the outcome, and bias in selection of the reported result. Discrepancies in the assessment results were discussed and reviewed by all authors before a consensus decision. The studies were on the low risk on standard scale comparable to high-quality randomized trial, and very few on moderate risks were also considered sound evidence for a non-randomized study (see **Figure 2**).

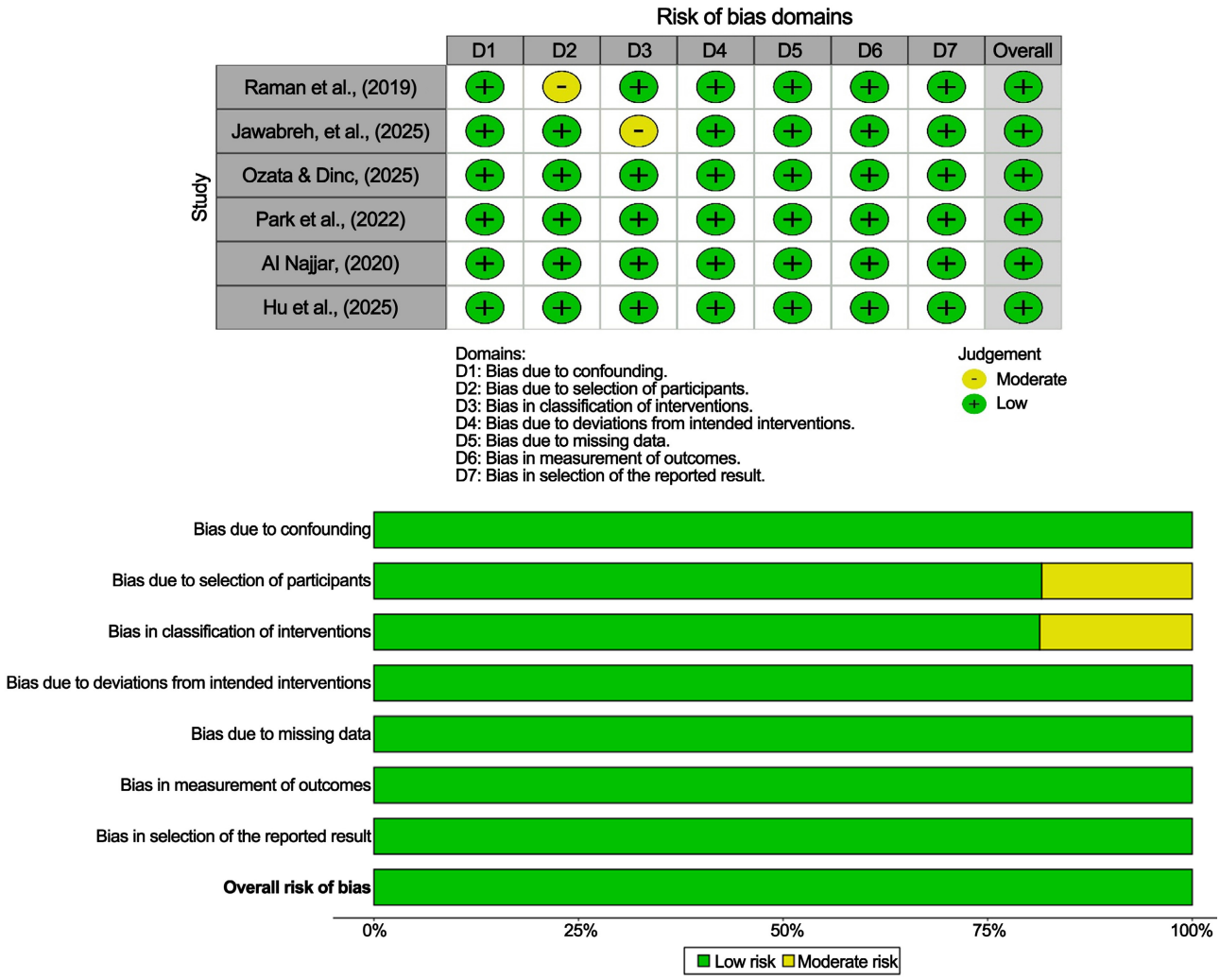

Figure 2. Risk of bias domains.

3.3. Data Extraction

All authors agreed to use Google Drive to verify data accuracy. The first author extracted details from eligible studies into a spreadsheet. All the authors checked the data in the spreadsheet to ensure data integrity. Missing details were addressed through comments on Google Drive.

3.4. Data Synthesis

Data were entered into SPSS version 31 software [22] by the first author. The effect size, weight, standard deviation, and 95% confidence interval (CI) were calculated for each study. The overall effect size, no effect value, and overall effect size value from pooled studies were also calculated on forest plot. Homogeneity and heterogeneity between the combined studies were tested using a standardized chi-square test. Homogeneity was <0.001, and heterogeneity was significantly high with I^2 of 76% - 88%. A P-value of <0.10 for the test of heterogeneity triggered the use of a random-effects model with all analyses.

4. Results

4.1. Description of Studies

This systematic review included six primary studies examining the effectiveness of HFS in pre-licensure nursing programs on student nurses' knowledge, skills, and confidence (Table 1). The selected six studies with 402 nursing students from various universities compared the effects of high-fidelity simulation and traditional teaching methods on nursing students' confidence, knowledge, and skills. Geographically, the studies were conducted in the Sultanate of Oman, Jordan, Türkiye, South Korea, Kingdom of Saudi Arabia, and China, all the six countries within five regions. [15] had 74 students (40 in the TCT group and 34 in the TCT + HFS group) from a cohort of nursing students and compared the effects of a combination of traditional clinical training with high-fidelity simulation (TCT + HFS) activities vs TCT alone on the clinical competency and knowledge among students enrolled in a maternity nursing course. [23] had 75 nursing students from Arab American University Palestine and An-Najah National University and evaluated the efficacy of employing high-fidelity simulation (HFS) in enhancing mental health nursing students' practice, satisfaction, and self-confidence in contrast to a group of students undergoing traditional nursing education methods.

Table 1. Main characteristics of the studies included in the review.

Authors/ Year	Country	Study Title	Publication Type	Study Design	Population and Sample Size	Aims
Raman *et al.*, 2019	Sultanate of Oman	Traditional clinical training combined with high-fidelity simulation-based activities improves clinical competency and knowledge among nursing students on a maternity nursing course	*Nursing Forum*, *54*(3)	A quasi-experimental research design was adopted in the study. A researcher-designed knowledge questionnaire was used to assess knowledge levels among the nursing students. The questionnaire consisted of 29 multiple-choice questions. The questions were content validated and peer reviewed. The test-retest reliability of the questionnaire was 0.86, hence the questions were found to be reliable.	The sample consisted of 74 students (40 in the TCT group and 34 in the TCT + HFS group) from a cohort of nursing students in a Middle Eastern university.	This study compared the effects of a combination of traditional clinical training with high-fidelity simulation (TCT + HFS) activities vs TCT alone on the clinical competency and knowledge among students enrolled in a maternity nursing course in a Middle Eastern public university.
Jawabreh, *et al.*, 2025	Jordan	Effectiveness of high-fidelity simulation on practice, satisfaction, and self-confidence among nursing students in mental health nursing class	*BMC Nursing*, *24*(1)	A quasi-experimental pre and post-test, two groups study. Educational Practices Questionnaire-Curriculum (EPQ-C) is a 22-item instrument using a five-point Likert scale. Reliability testing demonstrated strong internal consistency (Cronbach's alpha = 0.94). The Learner Satisfaction and Self-Confidence in Learning (LSSCL) scale, developed by the National League for Nursing, consists of 13 items on a five-point Likert scale. Cronbach's alpha coefficients for the LSSCL subscales were satisfactory (satisfaction = 0.92, self-confidence = 0.89). self-confidence in learning (eight items, scores ranging from 8 to 40).	75 nursing students from Arab American University Palestine and An-Najah National University.	The purpose of the study was to evaluate the efficacy of employing high-fidelity simulation (HFS) in enhancing mental health nursing students' practice, satisfaction, and self-confidence in contrast to a group of students undergoing traditional nursing education methods.
Ozata & Dinc, 2025	Türkiye	Effects of high-fidelity simulation and e-learning methods on nursing students' self-efficacy in patient safety: a quasi-experimental study	*BMC Nursing*, *24*(1)	A quasi-experimental study. 36 items rated on a five-point Likert scale patient safety competency self-efficacy scale (PSCSES) to assess nursing students' self-perceived proficiency in patient safety Scoring is based on the average item scores for each sub-dimension and for the overall scale. Higher scores indicate greater proficiency in patient safety. The scale demonstrates high internal consistency, with a Cronbach's alpha coefficient of 0.95.	52 senior nursing students enrolled at a state university in Ankara. Participants completed a pre-test and were randomly assigned to either high-fidelity simulation group or an e-learning group, with 26 students in each.	This study aimed to evaluate the impact of e-learning and high-fidelity simulation methods on the self-efficacy of nursing students.

Continued

Park *et al.*, 2022	South Korea	Learning effects of virtual versus high-fidelity simulations in nursing students: a crossover comparison	*BMC Nursing*, *21*(1)	A quasi-experimental, crossover-design study. 8 items on a 5-point Confidence scale provided by National League for A higher score indicates higher confidence after the simulation experience. Cronbach's α was 0.73. Nurses Clinical Reasoning Scale (NCRS) scale on which a high score on a 5-point scale of 15 questions indicates high clinical reasoning capability. Cronbach's α was 0.91.	52 students who had enrolled in the course.	The study utilized a quasi-experimental, crossover design that applied VS and HFS in a different order to determine differences in 1) the problem-solving process, 2) clinical reasoning, 3) reflective thinking, 4) satisfaction with the practicum, and 5) self-confidence.
Al Najjar, 2020	Saudi Arabia	Effectiveness of team-based learning with high fidelity simulation in an undergraduate pediatric course for nurses	Saudi Journal for Health sciences, 9(1)	The study had a two-group posttest only experimental design. A 13-item questionnaire that measured attitude toward TBL (Traditional Based Learning). The questionnaire was a five-point Likert type scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). The questionnaire was developed by the author of the study based on similar studies was pretested in 30 participants and the Cronbach's alpha value was 0.87.	The students (n = 81) included in the study were enrolled in pediatric nursing course at the College of Nursing in the university. They were assigned into two groups (sections) by a random computer-generated allocation system, by the academic office, at the time of registration in the course.	The aim of this study was to compare the effects of "conventional TBL" (CTBL) and "TBL combined with high fidelity simulation" on student's attitude and test performance.
Hu *et al.*, 2025	China	Effect of high-fidelity human patient simulator manikins combined with standardized patient simulation scenario on clinical thinking in pediatric nursing education	*BMC Nursing*, *24*(1)	A quasi-experimental pretest-posttest design was employed in this study. The scale was evaluated by the students themselves, comprising a total of 24 entries in three subscales, namely, critical thinking (entries 1 - 6), systematic thinking (entries 7 - 17), and evidence-based thinking (entries 18 - 24). Scoring used a 5-point Likert scale and a score range of 24 - 120, with higher scores indicating better clinical thinking ability. The Cronbach's α = 0.91, and the Cronbach's α of each dimension is 0.82, 0.80, and 0.78, respectively.	The people who took part were 68 full-time third-year nursing students from a university in Hunan, China.	The aim of the study is to evaluate the development of nursing students' clinical thinking after participating in clinical simulation and to compare the acquisition of nursing skills with students from previous years.

[10] had 52 senior nursing students enrolled at a state university in Ankara. Participants completed a pre-test and were randomly assigned to either high-fidelity simulation group or an e-learning group, with 26 students in each, and the study evaluated the impact of e-learning and high-fidelity simulation methods on the self-efficacy of nursing students. In [14], the participants were 52 students who had enrolled in the course, and the study applied VS (virtual simulation) and HFS (high-fidelity simulation) in a different order to determine differences in 1) the problem-solving process, 2) clinical reasoning, 3) reflective thinking, 4) satisfaction with the practicum, and 5) self-confidence. [13] with 81 students compared the effects of "conventional TBL" (CTBL) and "TBL combined with high fidelity simulation" on student's attitude and test performance. With [12], the participants were 68 full-time third-year nursing students, and the study evaluated the development of nursing students' clinical thinking after participating in clinical simulation and compared the acquisition of nursing skills with students from previous years (see **Table 1**). All participants were fully enrolled undergraduate students from seven universities, and with a range of 2 - 4 years as nursing students (see **Table 2**).

Table 2. Demographic characteristics of participants in the study.

Author(s)	Year	# of Participants	Name of Higher Institutions	Status of Students' Education	Country	Region
Raman *et al.*	2019	74	National university in Oman	Level 4 undergraduate	Sultanate of Oman	Southwestern Asia
Jawabreh *et al.*	2025	75	Arab American University Palestine (AAUP) and An-Najah National University	Undergraduate nursing enrolled in psychiatric mental health course	Jordan	Southwestern Asia
Ozata & Dinc	2025	52	State university in Ankara	Fourth-year nursing students	Türkiye	Transcontinental Europe and Asia
Park *et al.*	2022	52	Department of Nursing, Wonju College of Medicine, Yonsei University	Junior year 2 students enrolled in clinical practicum of maternity nursing	South Korea	Northeast Asia
Al Najjar	2020	81	King Saud bin Abdulaziz University	All students were enrolled in pediatric nursing course at the College of Nursing in the university	Kingdom of Saudi Arabia	Western Asia-Arabia Peninsula
Hu *et al.*	2025	68	Xiangya School of Nursing, Central South University	Undergraduate (third year) in pediatric course	China	East Asia

4.2. Results of the Meta-Analysis

To answer the research question on the impact of high-fidelity simulation on student nurses' confidence, knowledge, and skills, the following analyses were performed. On knowledge, [15] was not statistically significant at 0.25, 95% CI [−0.21, 0.71], P = 0.29, and [10] was not statistically significant at −0.27, 95% CI [−0.82, 0.28], P = 0. 33. However, the overall pool of the studies on the effect of high-fidelity simulation on knowledge was statistically significant, a random-effects meta-analysis revealed a significant positive effect, 0.74, 95% CI [0.16, 1.31], P = 0.01 (see **Figure 3**). The forest plot on the effect of high-fidelity simulation on skills was statistically significant, a random-effects meta-analysis revealed a significant positive effect, 0.70, 95% CI [0.17, 1.23], P = 0.01 (see **Figure 4**), while the independent few studies were not statistically significant as follows: [15] was not statistically significant at −0.08, 95% CI [−0.38, 0.54], P = 0.74 , and [10] was not statistically significant at 0.28, 95% CI [−0.45, 0.64], P = 0.73, [14] was not statistically significant at 0.53, 95% CI [−0.03, 1.08], P = 0.06 (see **Figure 4**). The overall pool of the five studies on the effect of high-fidelity simulation on confidence was statistically significant, a random-effects meta-analysis revealed a significant positive effect, 0.60, 95% CI [0.17, 1.03], P = 0.01 (see **Figure 5**). However, [10] was not statistically significant at −0.14, 95% CI [−0.69, 0.40], P = 0.60.

Comparison of high-fidelity simulation and conventional traditional learning influence on skills was shown in **Figure 5**.

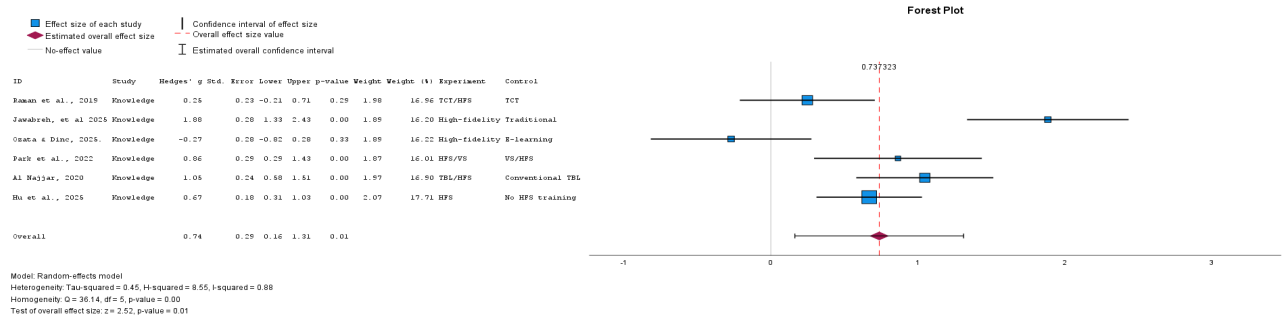

Figure 3. Comparison of high-fidelity simulation and conventional traditional learning influence on knowledge.

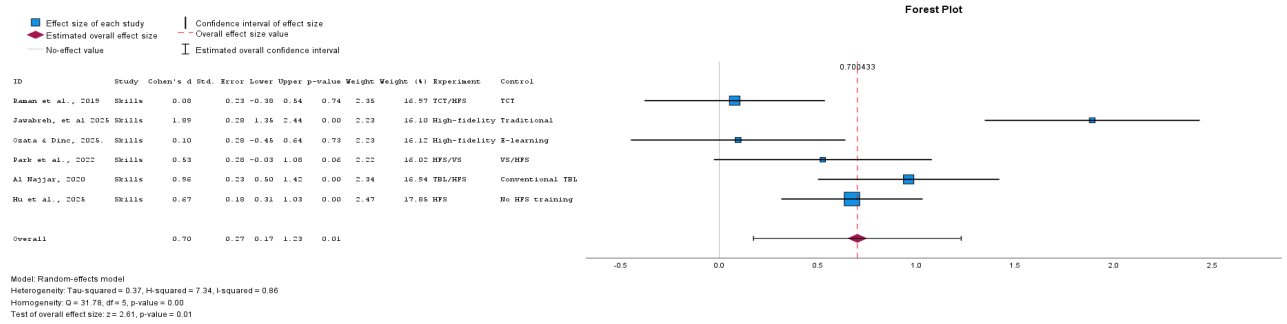

Figure 4. Comparison of high-fidelity simulation and conventional traditional learning influence on skills.

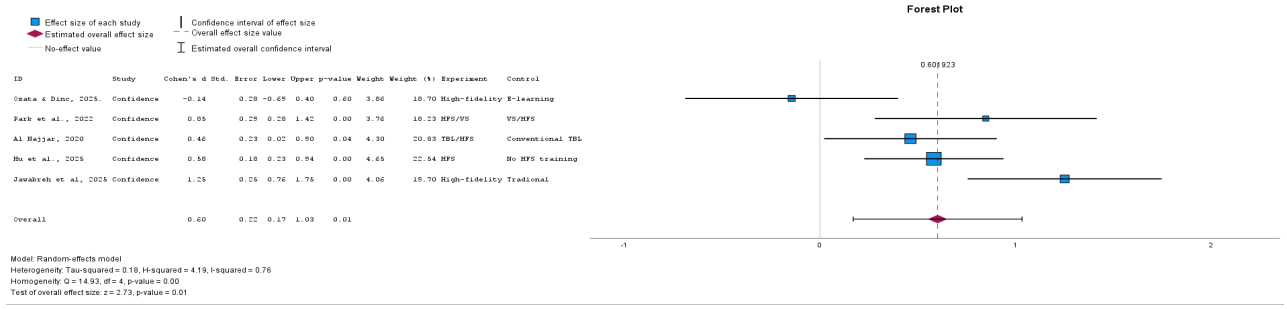

Figure 5. Comparison of high-fidelity simulation and conventional traditional learning influence on confidence.

4.3. Heterogeneity-Focused Analysis

A random-effects model was applied to address the heterogeneity observed in the

Table 3. Heterogeneity measures on confidence and skills.

Confidence	Tau-squared	0.182
	H-squared	4.186
	I-squared (%)	76.1
Skills	Tau-squared	0.371
	H-squared	7.336
	I-squared (%)	86.4
Overall	Tau-squared	0.252
	H-squared	5.426
	I-squared (%)	81.6

study. The subgroup analysis focused on comparison of high-fidelity simulation versus traditional learning methods on both student nurses' confidence and skills. The heterogeneity of the subgroup revealed 76.1% on confidence, 86.4% on skills, and 81.6% for the overall (Table 3). The overall pool effect-size was statistically significant, random-effects meta-analysis revealed a significant positive effect, 0.65, 95% CI [0.32, 0.99], P < 0.01 (Figure 6). The effect size of the subgroup was found to be statistically significant (2-tailed P < 0.01 (Table 4).

Table 4. Effect size estimates for subgroup analysis.

	Effect Size	Std. Error	Z	Sig. (2-Tailed)	95% Confidence Interval	
					Lower	Upper
Confidence	0.602	0.2202	2.734	0.006	0.170	1.033
Skills	0.700	0.2688	2.606	0.009	0.174	1.227
Overall	0.655	0.1689	3.877	<0.001	0.324	0.986

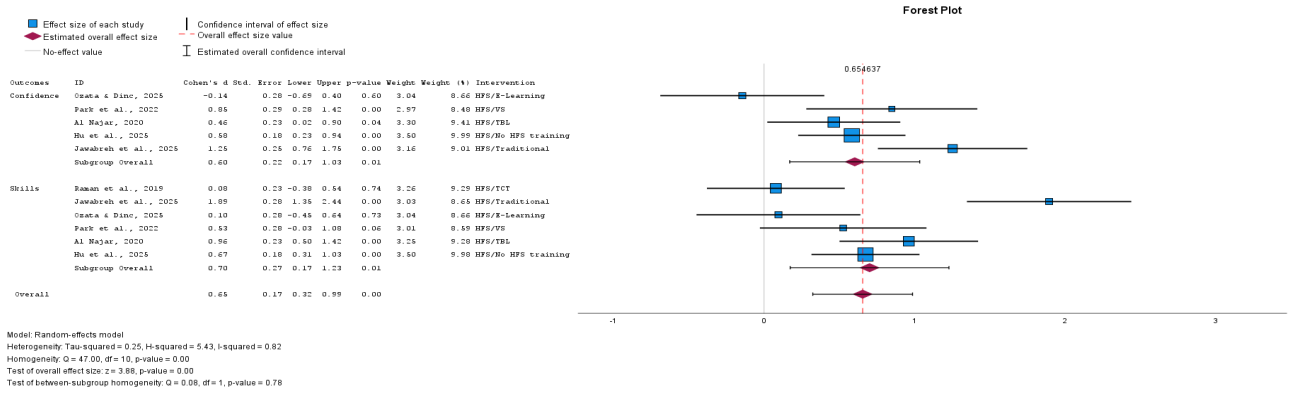

Figure 6. Test of between-subgroup homogeneity.

5. Discussion

In this study, we critically evaluated and analyzed the effects of high-fidelity simulation in prelicensure nursing programs as it relates to the confidence, knowledge, and skills of student nurses. The overall pooled results were statistically significant, amidst few insignificant independent studies. More hands-on experience and real-world applications of knowledge can enhance students' understanding and mastery of materials, leading to increased self-confidence [23]. Providing adequate and quality clinical training to student nurses is a major issue in nursing education [15]. This has necessitated the use of high-fidelity simulation to bridge the chasm. Simulation is an alternative or complementary method for students who cannot obtain sufficient direct care experience, as it allows students to experience various clinical situations [14]. The included studies in our review were nursing students from various universities in six different countries, thereby making the findings globally relevant. It has been suggested that high-fidelity simulation can replace up to 50% of traditional clinical training experiences in obstetrics, pediatrics, critical care, and mental health nursing [24]. As clinical space availability declines,

education-based simulations offer innovative alternatives to achieve comparable or improved outcomes [24]. High-fidelity modalities can provide realistic and authentic learning experiences that can be replicated for multiple cohorts across various locations, delivering consistent and effective educational opportunities [7]. Another study found significant learning curves for novice and intermediate students after virtual reality simulation-based curriculum and postulated that competencies acquired during the educational course may provide an important advantage for training prior to actual clinical practice [25]. This systematic review synthesized data from several studies to provide a clearer understanding of these outcomes.

The confidence of a nurse plays a pivotal role in clinical performance in all care settings. Lack of confidence leads to negative attitudes, resentment, anxiety, and aggression in practice areas. According to [14], self-confidence refers to students' confidence in nursing implementation, and it was measured by 8 items on a 5-point scale provided by National League for Nursing. The 8 items in the self-confidence subscale address aspects of confidence in mastering simulation content and skills, using helpful resources, student responsibility in learning, knowing how to seek help, and utilizing simulation effectively. Obviously, knowing how to seek help emanates from personal confidence and better communication strategy. A systematic review composed of 15 studies indicated that high-fidelity simulation significantly improved nursing students' knowledge and communication skills [23]. Most students show increased confidence in their nursing abilities after participating in simulations [12]. Confidence and clinical competence have been intricately intertwined with nursing students. A study indicated that the clinical competence and self-confidence of nursing students were effectively increased when they used the high-fidelity stimulation in conjunction with standardized patient simulation scenarios [12]. Another study showed that virtual simulation worked in advance to assist learners' thinking flow, which helped them assess the clinical situation and select an intervention to prioritize, and it served as pre-learning for high-fidelity simulation practice in which knowledge, skills, and attitudes were integrated, thereby enhancing self-confidence [14]. [10] did not observe any difference between students who underwent high-fidelity simulation and those who participated in e-learning due to closeness of the technological methods. However, both high-fidelity simulation and e-learning methods effectively enhanced students' self-efficacy regarding patient safety [10]. It was noted in a study that high fidelity simulation reduces anxiety in pediatric nursing students and allows them to experience joy of learning [13].

Learning is an essential component of nursing education to acquire knowledge. It involves the acquisition of knowledge from different fields, prioritizing patients, analyzing information from the most reliable sources, and developing a personalized plan that can be implemented and modified [12]. The personalized feedback log-in simulation exercise for nursing is noted to help learners increase their reflective thinking [14]. Simulations usually focus on a specific case, providing students

with a concrete scenario to suggest nursing techniques, establish a care plan, and implement it, helping them apply their knowledge to clinical concerns [12]. The overall test scores also favored the group with high fidelity simulation [13]. Through high-fidelity simulation, nursing students acquire knowledge in patient care, psychomotor skills, problem-solving, professional communication, and critical thinking [23]. In a study, the test performance of students who completed high-fidelity simulation application exercise was better than that of the group of students who solved case studies during traditional-based learning [13]. The effect of high-fidelity on the knowledge of nursing students was scientifically supported by this review [12]-[14] [23].

This review demonstrated the effects of high fidelity on nursing students' skills. In a study, the findings indicated that the test performance of students in Group 2 was better than Group 1 in cognitive assessment domain, which tested their analytical and application skills [13]. A study revealed that students who participated in the combined high-fidelity human patient simulator manikins and standardized patient simulation scenarios scored higher on nursing skills than the previous students [12]. Another study showed that high-fidelity simulation improved practice when managing airways and promoted their socializing and confidence in their professional roles [23]. Satisfied and self-confident students are more likely to master content, develop competencies, and apply skills in a clinical setting [26]. In a pre-test post-test quasi-experimental design that assessed the effectiveness of high-fidelity simulation on satisfaction, self-confidence, self-efficacy, and knowledge of undergraduate students in oncology care, it found significant differences between the experimental and control groups [27]. A quasi-experimental design that tested the efficacy of simulation versus case scenario as a teaching method for novice nursing students in nasogastric tube skills showed a significant improvement in the mean scores of competencies between the intervention and control groups [28]. The main limitation of this systematic review was the absence of a registered protocol prior to data collection. Nonetheless, this systematic review adhered to the PRISMA guidelines, ensuring transparent and accurate reporting and allowing for the replication of study methods.

6. Strengths and Limitations

The strength of our systematic review lies in its comprehensive inclusion of studies on the effectiveness of high-fidelity simulation on nursing students' confidence, knowledge, and skills conducted across six different countries and five regions, searching five databases. We collected data from experimental and quasi-experimental studies and conducted meta-analysis on the effectiveness of high-fidelity simulation on nursing students' confidence, knowledge, and skills. The heterogeneity in the studies was very high, as evident by I^2 of between 76% - 88%, therefore we used a random-effects model in all the analyses. The study focused primarily on high-fidelity simulation at the expense of other interventions such as virtual reality and e-learning, but the authors were concerned with the students'

confidence, skills, and knowledge. Our review brought into focus those attributes essential for nursing students to become competent professionals upon graduation and ensure safety of patients. The inclusion of articles written in English language only was a limitation because articles written in other languages such as Mandarin Chinese, German, French, Spanish, and Arabic, might have contributed certain scientific information to this study, but for the paucity of time and resources. Another limitation is the selection of six studies out of the 1767 articles, but the authors used PRISMA guideline to eliminate redundant articles, and a total of 402 students from various universities were included in the studies. The studies were conducted in various universities, and the educational levels of all the undergraduate student nurses varied from 2 - 4 years, thereby adding to the limitation of the review. However, the diversity of the participants brought concrete evidence to the effectiveness of high-fidelity simulation based on the outcomes of the analyses.

7. Conclusions

7.1. Implications for Practice

This review supports the effectiveness of high-fidelity simulation in prelicensure nursing education. According to the American Organization of Nurse Executives, the gap between nursing education and practice will not be bridged until baccalaureate curricula address the complexities and rapid changes in nursing practice [29]. It has been suggested that nursing education requires radical revisions to meet the knowledge and skills demands of the profession. Students' skills, knowledge, and confidence can be significantly enhanced through simulation. Human patient simulation has gained widespread acceptance for training healthcare professionals at all levels. With limited clinical sites, faculty shortages, and ethical and safety concerns, simulation-based clinical education has become the best instructional way for nursing students to develop clinical and decision-making skills without compromising the patient's well-being [30].

An increasing focus on quality, acuity, safety, and specialized and complex clinical practice emphasizes the need to incorporate innovative experiential learning. Many patient situations can be replicated using high-fidelity simulation to help students develop their nursing skills and competency. High-fidelity simulation bridges the gap between knowledge and clinical practice, especially when clinical opportunities are limited. It can be incorporated through role-playing, computer-assisted instruction, task training, and low- to high-fidelity manikins. The use of high-fidelity simulation in nursing education provides opportunities to practice clinical reasoning skills in controlled environments [31]. High-fidelity simulation is widely noted in healthcare as being realistic and positively contributing to skill acquisition within registered nursing education [7].

Simulations also increase satisfaction and confidence levels; however, these factors require further study among student nurses. High-fidelity simulation has been described as an innovative teaching tool used in healthcare education to support

learning and prepare nurses to provide safe and competent care in complex healthcare settings (Williams, 2019) [1].

7.2. Implications for Research

The overall pooled results of our review demonstrated statistical significance. However, more studies need to be done to find out strategies to enhance the effectiveness of high-fidelity simulation among nursing students. Many studies have supported the effectiveness of high-fidelity simulation in prelicensure nursing programs; however, a gap still exists on how confidence affects the skills and knowledge of nursing students. In most studies, the groups exposed to simulation method achieved better skills and knowledge than those exposed to traditional method, but personal attributes such as intelligence and the infrastructures available in various schools and universities must be taken into consideration. Future research should explore the factors that enhance students' confidence, satisfaction, skills, and knowledge when using high-fidelity simulation-based learning. Additionally, examining the relationship between confidence and skills could provide more insights into the effectiveness of high-fidelity simulation. As millennial and Generation Z nurses enter the field, further research is needed to identify key factors for improving the implementation of high-fidelity simulation.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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