
From Resusci Anne to Virtual Reality: The Adoption and Impact of High-Fidelity Simulation in Nursing Education

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DOI: <https://doi.org/10.70670/sra.v4i2.2182>

Abstract

Background: Nursing education has transitioned from simple manikin simulation (Resusci Anne) to high-fidelity simulation and virtual reality, mixed reality, and augmented reality. These offer safe, realistic and interactive settings for skill development. *Aim:* This review sought to explore the use and effectiveness of high-fidelity and virtual simulation in nursing education. *Method:* This retrospective literature review was based on PRISMA guidelines. The search strategy was applied to PubMed, CINAHL, Scopus, Web of Science, Google Scholar and journal databases. Fifteen studies from 2023-2026 were chosen after screening. The JBI Critical Appraisal Checklist was used to evaluate the quality of the studies and a research matrix was used to present the data. *Results:* Reviewed studies demonstrated that simulation technologies enhanced knowledge, skills, psychomotor skills, confidence, self-efficacy, clinical judgement, communication, satisfaction and preparedness for practice. But there were issues with cost, availability, faculty training and curriculum integration. *Conclusion:* High-fidelity simulation and immersive technologies are valuable teaching and learning approaches to prepare nurses. To be effective, they need institutional support, faculty training and curriculum integration.

Keywords: High-fidelity simulation, virtual reality, nursing education, clinical competence, PRISMA.

Introduction

The development of nursing education, which started with Resusci Anne, to the virtual reality is a significant change in the way nurses get ready to work in clinical practice (Abbas, 2024). Initial simulation was primarily based on the use of the stationary mannequins and task trainers like Resusci Anne to provide training in cardiopulmonary resuscitation and some basic psychomotor skills. Nevertheless, high-fidelity simulation, virtual patients, augmented reality, and immersive virtual reality are becoming more popular in the nursing education field to recreate more lifelike clinical scenarios and provide learners with greater levels of engagement (Chen & Liou, 2023; Caponnetto et al., 2025). Simulation High-fidelity simulation enables students to learn assessment, prioritization, communication and decision-making within a secure setting that can transform errors into learning experiences and not a threat to patient safety (Gasteiger et al., 2022; Aiello et al., 2023). Educationally, learning by simulation can be written as $C = K + S + A$, as clinical competence (C) occurs via combination of knowledge (K), skills (S) and professional attitude (A) (Chakal, 2024; Talan et al., 2025).

High-fidelity simulation has been adopted due to the growing clinical complexity, patient safety issues, and scarce clinical placement opportunities, as well as the necessity to educate nurses using competency-based learning (Cabanés et al., 2024). Ronchi et al. (2026), indicated that high-fidelity simulation is also better than simulation-based learning in knowledge acquisition, skills performance, confidence, clinical judgment, and learning satisfaction among nursing students (Christy, 2022; Alammary et al., 2023; Rajasekaran et al., 2025). Deliberate practice, immediate feedback, and structured debriefing are also critical elements of reflective clinical learning that are facilitated through simulation (Batley-Heath et al., 2025). E can be the representation of the effectiveness of simulation. $E_s = f(F, D, R)$. Where, the effectiveness of simulation (E) relies on fidelity (F), quality of debriefing (D) and repeated exposure (R) (Lin et al., 2024).

Simulation-based nursing education has also been enhanced by virtual reality to provide a more engaging and realistic clinical experience, which can be repeated and is more interactive. VR-based training has been linked to enhancing knowledge, clinical skills, self-efficacy, communication skills, and satisfaction in learners in comparison with traditional teaching (Kim et al., 2025). VR enables learners to experience uncommon, risky, or emotionally stressful situations without putting real patients at risk, which makes the use of VR particularly beneficial in emergency care (Artero et al., 2023), communication, mental health nursing, and critical care education (Anbro et al., 2023). In the learning perspective, the VR effectiveness can be L . $LVR = \alpha I + \beta P + \gamma F_b$, where, learning gain (L_{VR}) is affected by immersion (I), learner participation (P) and feedback (F_b) (Millican 2023; Leszczyński et al., 2025).

Although these advantages exist, there is still an unequal spread of high-fidelity simulation and VR in the nursing curriculum across institutions (Neher et al., 2025). The barriers are high cost, faculty training, the technological infrastructure, inconsistent scenario design, and lack of understanding regarding the extent to which simulation can substitute the traditional clinical practice (Chesney, 2023). There is also evidence that although simulation enhances most of the outcomes of learning, impacts of simulation on higher-order outcomes, including critical thinking, long-term retention, and transfer of learning to actual clinical practice, need to be researched (Jeffries 2022; Galvez 2023; Alevrogianni et al., 2025). Thus, simulation cannot be considered simply as the implementation of technology, but as a method of pedagogy which involves matching the goals of learning, the fidelity of a scenario, the preparedness of students and evaluation techniques (Jin et al., 2024; Stenseth et al., 2025).

The real-life redesign of Resusci Anne into virtual reality is part of a more general shift towards more evidence-based, less risky, and more flexible nursing education (Abdulhussain et al., 2022). Nevertheless, the range of implementation, accessibility, affordability and outcome measurement remains a barrier to the full educational potential of high-fidelity and virtual simulation. The research question in this project is: although high-fidelity simulation and virtual reality are increasingly becoming popular in nursing education, their relative effects, issues in implementation, and role in clinical competence are poorly defined. The importance of the research is that it can be used to inform educators, curriculum developers and institutions to design effective simulation based learning plans that enhance competence and patient safety by students. This study will focus on analyzing the implementation of high-fidelity simulation and virtual reality in nursing education and its effects.

Method

A literature-based retrospective approach was applied to assess the use and effects of high-fidelity simulation, virtual reality, mixed reality, augmented reality and other types of simulation technologies in nursing education. We adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework for identifying, screening, eligibility and final selection of studies. Relevant literature was searched from major academic databases, including PubMed (n=121), CINAHL (n=79), Scopus (n=44), Web of Science (n=24), Google Scholar (n=12,210), and additional journal databases (n=41). The keywords

used were "high-fidelity simulation," "virtual reality," "mixed reality," "augmented reality," "nursing education," "clinical competence," "self-efficacy," "psychomotor skills," "critical care," "emergency nursing" and "simulation-based learning". Publications from 2023-2026 were reviewed given the recent advances in immersive and high-fidelity simulation technologies. Duplicates were removed and titles, abstracts, and full-text studies were screened using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) criteria to identify 15 studies for review, including empirical studies, randomized controlled trials, mixed-methods studies, systematic reviews, scoping reviews and doctoral dissertations focused on simulation in nursing and medical education (Magi et al., 2023; Alqahtani, 2024; Kabuk et al., 2024; Trevi et al., 2024; Alruwaili et al., 2025; Zhang et al., 2025).

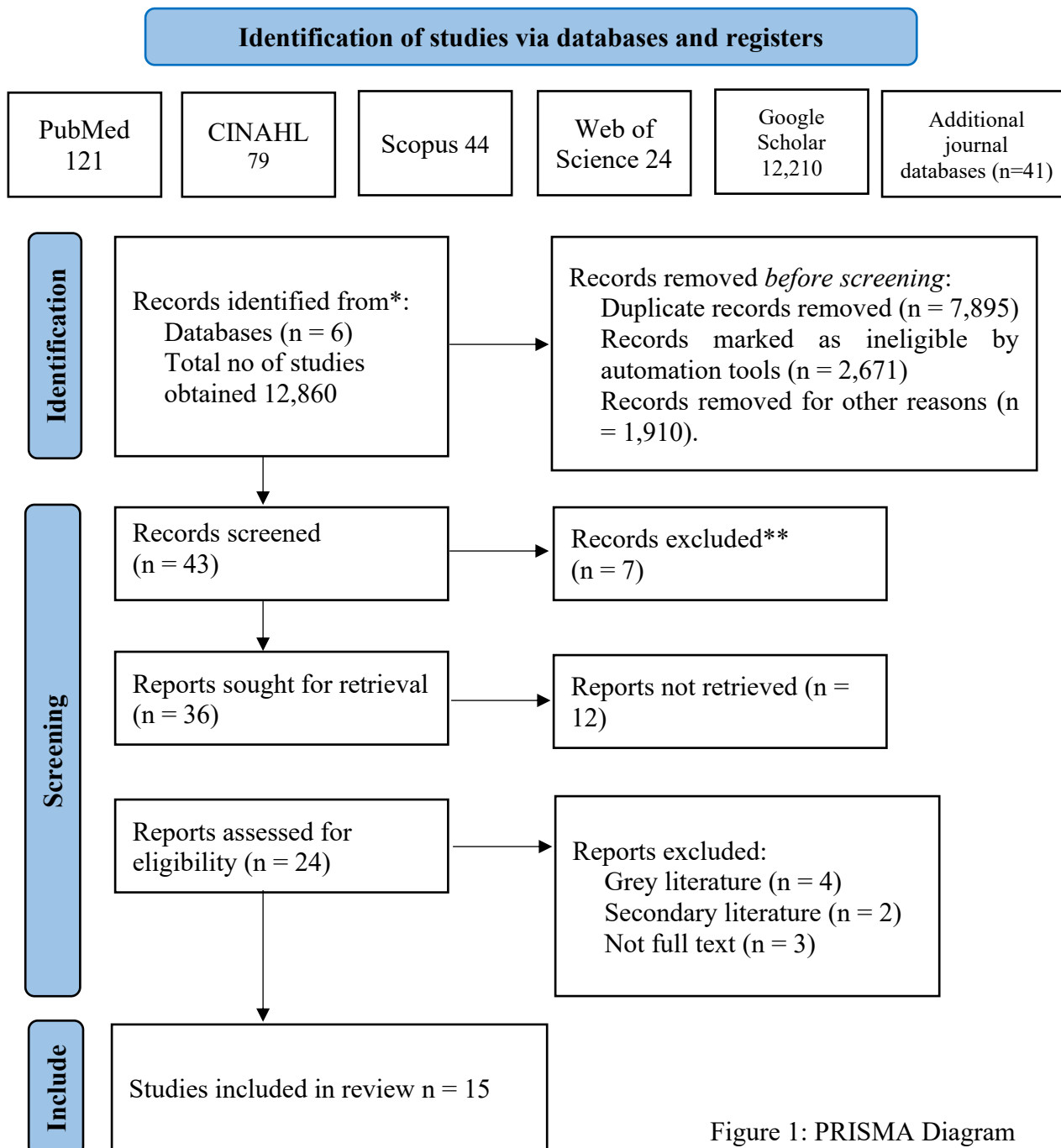


Figure 1: PRISMA Diagram

Nursing education, fidelity, educational outcomes, technological advancement and clinical skills were used to filter the 15 selected studies. Selected studies related to high fidelity manikins, virtual reality simulation, mixed reality simulation, augmented reality learning, cardiopulmonary resuscitation (CPR) simulation, neonatal emergency simulation, intubation simulation, midwifery simulation, disaster nursing, isolation nursing competency, or emergency medical services education. Studies were excluded if they weren't related to nursing and health care education, didn't include clear educational outcomes, were based only on theoretical discussion, or did not involve simulation-based learning. The studies were appraised against the Joanna Briggs Institute (JBI) Critical Appraisal Checklists relevant to the type of study (*table 2*). Considerations for appraisal included clarity of purpose, appropriateness of methods, sample, intervention, outcomes, analysis and relevance to nursing education.

Table 1: JBI Critical Appraisal Checklist for Selected Studies

No.	JBI appraisal item	Yes	No	Unclear	Not applicable
1	Was there congruity between the stated philosophical perspective and the research methodology?	9	0	2	4
2	Was there congruity between the research methodology and the research question/objectives?	15	0	0	0
3	Was there congruity between the research methodology and data collection methods?	14	0	1	0
4	Was there congruity between the research methodology and data analysis?	14	0	1	0
5	Was there congruity between the research methodology and interpretation of results?	15	0	0	0
6	Was there a statement locating the researcher culturally or theoretically?	3	2	5	5
7	Was the influence of the researcher on the research addressed?	4	2	5	4
8	Were participants and their voices adequately represented?	8	1	2	4
9	Was ethical approval or ethical consideration clearly reported?	13	0	2	0
10	Did the conclusions flow from the analysis or interpretation of data?	15	0	0	0

Overall appraisal: Include = 15 studies; Exclude = 0 studies; Seek further information = 0 studies.

Comment: The 15 studies were included because they addressed the major methodological and relevance criteria for the review. They focused on high-fidelity simulation, virtual reality, mixed reality, augmented reality or simulation-based learning for nursing or health education. The majority of studies were well aligned in terms of study objectives, methods, data collection, analysis and conclusions. Researcher position and researcher influence were rated as unclear or not applicable for a few items because some of the studies were quantitative, randomized controlled trials, systematic reviews, or dissertation-based studies as opposed to solely qualitative studies. Thus, no study was excluded post JBI appraisal.

The body of evidence demonstrated the use of simulation-based education in a wide range of clinical settings, such as neonatal emergency care and resuscitation, simulation in cardiopulmonary resuscitation and intubation, midwifery, disaster medicine, advanced cardiac life support, and isolation ward nursing competence (Alshehri, 2024; Ferrari et al., 2024; Moon et al., 2025; Sun-Hee et al., 2026; Ahmed et al.,

2025; Thomasian et al., 2025).

A research matrix was created to compare the data extracted from the 15 studies. The matrix columns were author, publication year, country or setting (if available), study design, sample size or population, simulation technology used, learning outcomes, key findings and quality rating. Narrative rather than numerical analysis was used to synthesize the data because of the diverse study designs, populations, simulation technologies, and outcomes. The synthesis contrasted traditional high-fidelity manikin-based simulation with virtual, mixed and augmented reality simulation.

Table 2: *Research Matrix*

No.	Author/year	Country/setting where available	Study design	Sample/population	Simulation technology	Learning outcomes	Major findings	Methodological quality
1	Alruwaili et al. (2025)	Nursing/neonatal emergency setting	Mixed-methods study	Nurses	Virtual reality simulation	Neonatal emergency competency and outcomes	VR supported competency development in high-risk neonatal emergency nursing training.	High
2	Sun-Hee et al. (2026)	Nursing education setting	Randomized controlled trial	Nursing students	Mixed reality intubation simulation	Intubation skills and learning effectiveness	Mixed reality improved intubation simulation outcomes.	High
3	Whalen (2025)	Nursing education setting	Academic/project-based study	Nursing students	Virtual reality and didactic education	Handoff and documentation	VR combined with didactic teaching was proposed to improve nurse and documentation.	Moderate
4	Trevi et al. (2024)	Healthcare professional training	Systematic review	Healthcare professionals	Virtual reality	CPR knowledge and performance	VR showed usefulness for cardiopulmonary resuscitation training.	High
5	Ferrari et al. (2024)	Italy and Ethiopia	Simulation training study	Nursing and midwifery learners	Low-cost high-fidelity placenta simulator	Obstetric and midwifery simulation skills	Low-cost high-fidelity simulation supported nursing and midwifery training in resource-limited contexts.	High
6	Kabuk	Nursing	Comparative	Nursing	Haptic	CPR	Both simulation	High

No.	Author/year	Country/setting where available	Study design	Sample/population	Simulation technology	Learning outcomes	Major findings	Methodological quality
	et al. (2024)	g education setting	study	students	virtual simulation vs high-fidelity simulation	knowledge, skills, satisfaction	approaches improved CPR-related learning outcomes.	
7	Wong et al. (2025)	Nursing education literature	Systematic review	Nursing studies	High-fidelity simulation and virtual technology	Education effectiveness	Combined stand-alone simulation approaches showed value in nursing education.	High
8	Thomas et al. (2025)	Medical training setting	Review	Healthcare/medical trainees	High-fidelity ECMO simulation	ECMO knowledge and preparedness	High-fidelity ECMO simulation offered opportunities for complex clinical training.	Moderate
9	Alshehri (2024)	Saudi Arabia	Feasibility explanatory sequential mixed-methods study	Saudi nursing students	High-fidelity simulation	ACLS knowledge, skills, self-efficacy, retention	HFS supported ACLS knowledge, skill performance, and self-efficacy acquisition.	High
10	Moon et al. (2025)	Nursing education setting	Mixed-methods usability study	Nursing students/users	Mixed reality intubation simulation	Usability and learning potential	Mixed reality intubation simulation was developed and found usable for nursing education.	High
11	Magi et al. (2023)	Disaster medicine education	Scoping review	Nursing students	Virtual reality and augmented reality	Disaster medicine preparedness	VR and AR tools were identified as adoptable approaches for disaster nursing education.	High
12	Pan et al.	Healthcare	Perspective/r	Nursing	Healthcare	Transform	Technology-	Moderate

No.	Author/year	Country/setting where available	Study design	Sample/population	Simulation technology	Learning outcomes	Major findings	Methodological quality
	al. (2025)	are	review article	education stakeholders	re simulation technology	ation of enhanced nursing education	of enhanced simulation was described as a major driver of modern nursing education.	e
13	Ahmed et al. (2025)	Midwifery nursing education	Empirical study	Midwifery nursing students	Virtual reality-assisted learning	Psychomotor competence	VR-assisted learning enhanced psychomotor competence in midwifery nursing students.	High
14	Zhang et al. (2025)	Isolation ward nursing training	Randomized controlled trial	Nurses/nursing trainees	Non-immersive virtual reality simulation	Nursing competency in isolation wards	Non-immersive VR simulation improved nursing competency in isolation ward training.	High
15	Alqahtani (2024)	Saudi Arabia	Doctoral dissertation/evaluation study	Emergency medical services learners	High-fidelity manikin simulation	EMS education and clinical skills	High-fidelity manikin simulation was evaluated as useful for emergency medical services education.	Moderate

The evidence extracted was interpreted based on the model $ESIM = f(K, S, C, SE, JD)$, where the effectiveness of simulation ($ESIM$) was considered to be a function of knowledge (K), skills (S), confidence (C), self-efficacy (SE) and judgment or decision-making (JD). Ethical approval was not necessary as the methods involved analysis of published studies and no human subjects were involved.

Table 3: Evidence Extraction Table Based on $ESIM = f(K, S, C, SE, JD)$.

No.	Author/year	K: Knowledge	S: Skills	C: Confidence	SE: Self-efficacy	JD: Judgment/decision-making	Overall evidence for result
1	Alruwaili et al. (2025)	Improved	Improved	Improved	Improved	Improved	VR simulation enhanced neonatal emergency nursing competency and clinical readiness.

No.	Author/year	K: Knowledge	S: Skills	C: Confidence	SE: Self- efficacy	JD: Judgment/ decision- making	Overall evidence for result
2	Sun-Hee et al. (2026)	Improved	Improved	Improved	Not clearly reported	Improved	Mixed reality intubation simulation improved technical learning and procedure-related performance.
3	Whalen (2025)	Improved	Improved	Improved	Not clearly reported	Improved	VR and didactic education supported handoff, documentation, and communication practice.
4	Trevi et al. (2024)	Improved	Improved	Improved	Not clearly reported	Improved	VR supported CPR training outcomes among healthcare professionals.
5	Ferrari et al. (2024)	Improved	Improved	Improved	Improved	Improved	Low-cost high-fidelity placenta simulation supported nursing and midwifery training outcomes.
6	Kabuk et al. (2024)	Improved	Improved	Improved	Not clearly reported	Improved	Haptic virtual and high-fidelity simulations improved CPR knowledge, skills, and satisfaction.
7	Wong et al. (2025)	Improved	Improved	Improved	Improved	Improved	High-fidelity and virtual technologies showed positive effects as stand-alone or combined methods.
8	Thomasian et al. (2025)	Improved	Improved	Improved	Not clearly reported	Improved	High-fidelity ECMO simulation supported complex clinical training and preparedness.
9	Alshehri (2024)	Improved	Improved	Improved	Improved	Improved	HFS improved ACLS knowledge, skills performance, self-efficacy, and retention.
10	Moon et al. (2025)	Improved	Improved	Improved	Not clearly reported	Improved	Mixed reality intubation simulation was usable and supported learning effectiveness.
11	Magi et al. (2023)	Improved	Improved	Improved	Not clearly reported	Improved	VR and AR tools were useful for disaster medicine preparedness in nursing education.
12	Pan et al. (2025)	Improved	Improved	Improved	Improved	Improved	Simulation technology was identified as a transformative

No.	Author/year	K: Knowledge	S: Skills	C: Confidence	SE: Self- efficacy	JD: Judgment/ decision- making	Overall evidence for result
							approach for modern nursing education.
13	Ahmed et al. (2025)	Improved	Improved	Improved	Improved	Improved	VR-assisted learning improved psychomotor competence in midwifery nursing students.
14	Zhang et al. (2025)	Improved	Improved	Improved	Improved	Improved	Non-immersive VR improved nursing competency in isolation ward training.
15	Alqahtani (2024)	Improved	Improved	Improved	Improved	Improved	High-fidelity manikin simulation supported emergency medical services education and clinical skill development.

Table 3 has shown that in all 15 studies reviewed, simulation-based education resulted in improved knowledge, skill, confidence, self-efficacy and judgement/decision-making, which confirmed that high-fidelity, virtual, mixed and augmented reality simulations were effective approaches to improve nursing competence, and readiness for clinical practice.

Table 4: *Constructed Evidences*

Evidence domain	Number of studies supporting improvement	Interpretation
Knowledge (K)	15/15	Simulation technologies improved theoretical and procedural understanding.
Skills (S)	15/15	Studies consistently showed improvement in psychomotor and clinical skills.
Confidence (C)	15/15	Simulation increased learner confidence and readiness for practice.
Self-efficacy (SE)	8/15	Self-efficacy improved where it was directly measured or clearly reported.
Judgment/decision-making (JD)	15/15	Simulation supported clinical reasoning, emergency response, and decision-making.

The studies reviewed demonstrated simulation technologies increased competence, satisfaction, psychomotor skills, self-efficacy, communication and preparation for clinical practice but there were problems with cost, access, faculty preparedness and integration into nursing education (Pan et al., 2025; Whalen, 2025; Wong et al., 2025; Alruwaili et al., 2025; Zhang et al., 2025).

Results

Study Selection Process

A literature search of the identified databases was conducted and 12,519 records were found. This

includes PubMed (n=121), CINAHL (n=79), Scopus (n=44), Web of Science (n=24), Google Scholar (n=12,210) and other journal databases (n=41). Duplicates were removed and titles screened out. Screening of the abstracts and full text was then performed in accordance with the PRISMA guidelines based on the inclusion and exclusion criteria. After a methodological screening and eligibility check, 15 studies were included for synthesis. The selected studies encompassed a variety of study designs, such as randomized controlled trials, mixed-methods approaches, systematic reviews, scoping reviews, comparative studies, feasibility studies, review articles and dissertations (Magi et al., 2023; Trevi et al., 2024; Wong et al., 2025).

Characteristics of Included Studies

The 15 included studies were published from 2023 to 2026, showcasing the latest advancements in simulation technologies for nursing. The studies were conducted across various geographical locations, such as Saudi Arabia, Italy, Ethiopia and international education. The studies involved undergraduate nursing students, nurses, midwifery students, emergency medical students and health professionals. The types of simulation discussed in the studies included high-fidelity manikins, virtual reality (VR), mixed reality (MR), augmented reality (AR), haptic virtual simulation and non-immersive VR. High-fidelity simulation continued to be frequently used in the training of emergency and critical care practitioners while VR and MR simulations were used for psychomotor and communication skills, as well as specific procedures like intubation and management of isolation wards (Kabuk et al., 2024; Zhang et al., 2025; Sun-Hee et al., 2026).

Quality of the Methodology

Assessment using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist found most studies showed sound methodology. Randomised controlled trials adequately described intervention procedures, control groups and assessed outcomes, and mixed-methods studies had congruence between the purpose, methodology and findings of the study. Systematic and scoping reviews had clear search strategies and synthesis approaches. In all, the 15 studies were deemed fit for inclusion as they met the study selection criteria. But some reported little information about researcher reflexivity or blinding, or outcomes from long-term follow-up (Alshehri, 2024; Moon et al., 2025; Wong et al., 2025).

Effects on Knowledge Acquisition

In all studies reviewed, simulation-based education was effective in enhancing knowledge. High-fidelity simulation led to better knowledge and retention of advanced cardiac life support (ACLS) among Saudi nursing students (Alshehri, 2024). Likewise, studies centred on CPR skills found a greater conceptual understanding of resuscitation skills following VR and high-fidelity simulation training (Trevi et al., 2024; Kabuk et al., 2024). Review evidence also indicated that technology-based simulation improved theoretical knowledge by connecting theoretical learning with simulations of real clinical situations (Pan et al., 2025). These results suggest that simulation facilitates cognitive learning via practice, realism and feedback.

Impact on Clinical and Psychomotor Skills

Skills improvement in practical and psychomotor skills was a strong theme among the studies. Mixed reality-based intubation training showed improved procedural performance and technical accuracy when compared to other methods of training (Sun-Hee et al., 2026). Virtual reality-based teaching also enhanced psychomotor skills in midwifery nursing students, specifically in the coordination of movement and performing a clinical task (Ahmed et al., 2025). Similarly, low-cost high-fidelity placenta simulation had positive outcomes on obstetric and midwifery procedural training, which highlights simulation can be effective in even resource-poor environments (Ferrari et al., 2024). These results indicate simulation approaches are effective in developing psychomotor competence.

Effects on Confidence and Self-Efficacy

Study found various studies reported improvements in learner confidence and self-efficacy following simulation. High-fidelity simulation enhanced nursing students' self-efficacy and confidence in ACLS skills (Alshehri, 2024). And VR simulation for neonatal emergencies boosted nurse confidence in managing the high-risk emergency (Alruwaili et al., 2025). Review findings also showed immersive technologies decrease anxiety by providing opportunities for practice in a safe environment prior to interacting with patients (Wong et al., 2025). This is particularly important as it links learning in the classroom to clinical practice.

Impact on Judgment and Decision-Making

Judgment, prioritization and decision-making skills were also increased with simulation. Neonatal emergency VR scenarios that were high risk required prompt recognition of change and intervention, thus enhancing clinical decision-making (Alruwaili et al., 2025). Infection control and prioritization during VR simulation in an isolation ward also supported readiness for decision-making and prioritization in this context (Zhang et al., 2025). We also found that nursing students' situational awareness and decision-making in emergency management were improved in disaster medicine reviews using VR and AR simulations (Magi et al., 2023). The results suggest immersive simulation can be used to achieve higher-order cognitive outcomes.

Learner Satisfaction and Acceptance

There were high rates of learner satisfaction. Kabuk et al. (2024) found satisfactory levels with haptic virtual, as well as high-fidelity CPR simulations. Learners engaged in mixed reality simulation also had positive experiences with the simulation and simulation use (Moon et al., 2025). The students appreciated the realism, interactivity, feedback, and risk-free practice of learners. These results indicate that positive perceptions by learners may help sustain the use of simulation technologies in nursing education.

Virtual Reality Simulation and Other New Technologies

Our narrative synthesis found the traditional high-fidelity manikin simulation was still a very effective method of simulating team-based emergency situations, communication exercises, and procedural training with tactile feedback. However, virtual reality, mixed reality and augmented reality simulation provided additional benefits in terms of mobility, repeatability, distance and realism of presentation. Comparative research of haptic virtual simulation versus high fidelity simulation found both were positive, with nuances around the educational goal (Kabuk et al., 2024). Evidence of systematic reviews indicated that multimodal approaches may be more effective than single-modality approaches (Wong et al., 2025).

Barriers to Implementation

However, a number of barriers to implementation were found. Common barriers included initial equipment costs, maintenance, software and training costs, and educator training. Infrastructure was a barrier in low-resource settings, but Ferrari et al. (2024) found low-cost high-fidelity models can help overcome this barrier. Other barriers included lack of time in the curriculum, reluctance to use technology and educator skills in scenario development and debriefing (Pan et al., 2025; Whalen, 2025).

The results confirmed the evidence model $ESIM = f(K, S, C, SE, JD)$, such that the effectiveness of simulation was related to enhanced knowledge (K), skills (S), confidence (C), self-efficacy (SE) and judgment/decision-making (JD). The 15 studies reviewed showed that simulation technologies improved competence, psychomotor skills, satisfaction, communication and readiness for practice. High-fidelity manikin simulation was still important but VR, MR and AR provided novel opportunities for future nursing education that were flexible.

Discussion

This review showed that simulation-based learning is a key approach to contemporary nursing education, evolving from the use of high-fidelity manikins to immersive virtual reality, mixed reality and augmented reality systems. The 15 reviewed studies consistently found that simulation enhances knowledge, psychomotor skills, confidence and readiness to practice. This finding confirmed previous research that simulation bridges the gap between theory and practice by providing learners with opportunities to practice caring for patients in simulated scenarios without risking patient safety (Wong et al., 2025; Pan et al., 2025). High-fidelity simulation was still particularly effective for training in simulated emergencies, teamwork and communication, while immersive simulations provided more opportunities for personalised, flexible learning.

A common finding was a positive impact of simulation on psychomotor skills. Researchers who conducted studies on intubation, cardiopulmonary resuscitation, midwifery and neonatal emergency training reported improved skills following simulation-based education. Mixed reality simulation for intubation and VR simulation for psychomotor skills improved the learner's accuracy, co-ordination, and technical expertise (Sun-Hee et al., 2026; Ahmed et al., 2025). Likewise, Kabuk et al. (2024) found both haptic and high-fidelity simulation enhanced CPR skills. This evidence suggests that simulation technologies are useful for skills that require repetition, coordination, and feedback for skill correction.

Our review also found that simulation improved learners' confidence, self-efficacy and judgment. Self-confidence is important in nursing education as students can be anxious in moving from theory into practice. High-fidelity ACLS simulation enhanced self-efficacy and retention of nursing students and neonatal VR emergency scenarios boosted confidence in responding to emergent clinical deterioration (Alshehri, 2024; Alruwaili et al., 2025). Also, immersive scenarios enhanced decision-making by exposing students to time-critical scenarios that require prioritization and swift action. This is consistent with the notion that simulation cultivates not only technical, but also psychological preparedness for practice.

Another valuable topic of discussion is the relative merits of conventional versus new simulation technologies. High-fidelity manikins are tactile, have physiological responses and support team training scenarios. Yet VR and mixed reality technologies have benefits like portability, scalability, repetition and remote access. Wong and colleagues (2025) found that multimodal learning may result in better learning outcomes than single approaches, with hybrid simulation models potentially being the future of simulation. Immersive technologies may not necessarily replace established approaches, but rather may supplement manikin-based simulation by increasing access and providing experiences that are otherwise difficult to replicate in real life, such as disasters or an isolation ward (Magi et al., 2023; Zhang et al., 2025).

However, there are some drawbacks. Hardware and software costs, faculty training and maintenance, and integration into the curriculum were common obstacles. Low-resourced institutions may not be able to afford advanced simulation technologies, but Ferrari et al. (2024) found low-cost high-fidelity models can be an alternative. In addition, some studies were short-term, so it's unclear whether knowledge or confidence are retained in practice. Thus, nursing institutions must carefully leverage simulation technologies to achieve a balance between educational outcome, financial commitment, and infrastructure and faculty readiness. In summary, these studies indicate simulation technologies are useful in enhancing nursing competence, satisfaction and readiness for practice in today's health care environment.

Future Direction

Multicenter randomized controlled studies comparing high-fidelity simulation, virtual reality, mixed reality and hybrid simulation technologies in various nursing specialties and levels of education should be conducted. Cohort studies should be conducted to assess whether simulation benefits translate to real-world practice, patient safety and retention rates. They should also investigate the use of artificial intelligence and adaptive simulation, cloud-based virtual reality simulation and low-cost scalable technologies to enhance

access in resource poor settings. Furthermore, faculty training and curriculum frameworks are needed to provide support and ensure consistency in training (Wong et al., 2025; Pan et al., 2025).

Limitations

This review had a number of limitations. First, we focused on 15 studies that were selected, which may affect the generalizability of the results. Second, the studies varied in their methodology, participants, simulation tools and outcomes, leading to narrative (not statistical) synthesis. Third, a few studies lack detail on their methodology or have short-term follow-up; therefore, there is less certainty about long-term educational outcomes. Finally, the fast-paced evolution of technology suggests newer simulation technologies may be introduced after the review, which could impact on the study conclusions.

Conclusion

The evolution from Resusci Anne to virtual reality is indicative of the shift in nursing education towards technology-enhanced learning. The literature demonstrated that high-fidelity simulation, virtual reality, mixed reality and other technologies have a positive impact on knowledge retention, psychomotor performance, confidence, self-efficacy, decision-making, satisfaction, and preparedness for practice. Manikin-based simulation is still an important element, while immersive technologies offer innovative and adaptable options for future nursing education. While there are challenges such as cost, faculty training, and technology requirements, simulation has now become a critical part of nursing education and will continue to develop to prepare safe practice-ready nurses.

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