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Original Research Article

Integrating Virtual Reality Simulation in Nursing Education: A Review on Enhancing Learning Outcomes and Clinical Experiences of Student Nurses

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Abstract

Virtual reality simulation (VRS) is increasingly used in nursing education as an innovative strategy to enhance learning outcomes. This review evaluates the effectiveness of VRS in developing clinical skills, cognitive skills, satisfaction, and self-confidence among nursing students. A systematic search identified 166 studies, of which eight met the inclusion criteria. Eligible studies were published between 2015 and 2021, focused on undergraduate nursing students, and employed experimental designs. Data were narratively synthesized due to heterogeneity in study designs and outcome measures. Evidence indicated that VRS was most effective in improving cognitive skills, with four studies reporting significant gains in knowledge and retention. Three studies demonstrated enhanced student satisfaction, while only one reported increased self-confidence. Clinical skill outcomes were mixed, with three studies showing significant improvement and two reporting no effect. Variability in technology, study design, and outcome assessment limited generalisability. VRS shows promise as an educational intervention, particularly for strengthening theoretical knowledge and learner satisfaction. Its impact on clinical skills and self-confidence remains inconclusive, highlighting the need for further high-quality research. As VR technology advances, VRS may complement traditional simulation by offering flexible, cost-effective, and engaging learning opportunities in nursing education.

Keywords: Clinical skills, cognitive skills, nursing education, nursing students, simulation training, self-confidence, technology-enhanced learning, virtual reality simulation (VRS)

INTRODUCTION

Clinical education forms the cornerstone of medical sciences, and enhancing the quality of clinical experiences and skill development among students requires effective training. Asadi (2023) emphasizes that while student learning in clinical environments is influenced by multiple factors, effective clinical education remains essential for the accurate delivery of patient care. Such training fosters critical thinking, strengthens decision-making abilities, and builds self-confidence in learners. Guiding students toward achieving clinical goals necessitates identifying effective behaviours and contextual factors, which explains why clinical education has been a central focus of recent research. Moreover, Asadi (2023) highlights that the persistent gap between theoretical instruction and practical application limits students' opportunities to acquire essential skills, making their perspectives as recipients of educational services invaluable for identifying challenges and improving clinical education practices. Elcokany et al. (2022) showed that video-based learning enhanced nursing students' competence and confidence, positioning them as modern digital learners. This supports the integration

of innovative tools such as virtual reality simulation to further strengthen experiential learning and clinical preparedness in nursing education.

Nursing education serves as a cornerstone in preparing healthcare professionals, designed to equip students with both theoretical understanding and practical clinical skills (Brown, 2018). Despite this objective, a major challenge persists in the form of the "theory–practice gap," where knowledge gained in academic settings often fails to fully translate into the competencies needed in real-world clinical practice (Onda, 2012). Effective clinical instruction plays a pivotal role in shaping nursing students' competence and confidence. A recent cross-sectional study highlighted that nursing students, faculty, and preceptors perceive professional expertise, supportive communication, and the ability to foster critical thinking as essential characteristics of effective clinical instructors. These findings underscore the importance of mentorship and positive learning environments in nursing education, reinforcing the relevance of integrating innovative teaching strategies such as video-based learning and virtual reality simulation to enhance student outcomes (Buanz et al., 2024).

Over the past few decades, clinical simulation has developed into a widely recognized and innovative teaching strategy. It provides controlled, interactive environments where realistic clinical scenarios can be recreated, giving students valuable hands-on practice without risking patient safety (Cant, 2017). Utilizing tools from simple manikins to advanced technologies like virtual reality and AI systems, simulation allows learners to engage with complex or uncommon clinical situations that they might not otherwise encounter in actual practice (Alharbi, 2024).

Simulation-based learning (SBL) can be implemented through varying levels of fidelity, including high, medium, and low (Munshi, 2015). High-fidelity SBL aims to replicate patient scenarios with a high degree of realism, while low-fidelity SBL emphasizes practicing essential skills in less complex environments that do not fully mirror the pressures of actual clinical practice (Butler, 2009). Although high-fidelity approaches are often assumed to provide greater educational benefits, research evidence does not consistently support this claim. For instance, Massoth et al. compared high- and low-fidelity SBL in advanced life support training and found no significant differences in knowledge or skill improvement between the two groups. Moreover, their sub-analysis revealed that participants in high-fidelity sessions were more likely to develop overconfidence in task performance, which the authors identified as a potential drawback of this modality (Massoth, 2019).

It is essential to explore simulation-based learning (SBL) more comprehensively through an in-depth review of the literature. Such an examination can clarify whether SBL effectively achieves its intended goals of enhancing knowledge, skill acquisition, and retention, while also contributing to ongoing discussions about fidelity. Previous reviews have provided valuable groundwork in this area; for instance, Al Gharibi and Arulappan conducted an integrative review assessing various outcomes among nursing students (Al Gharibi, 2020). Also, Labrague et al. carried out a systematic review with similar aims (Labrague, 2019). Augmented reality (AR) has emerged as a valuable educational support tool in nursing simulation, offering immersive and interactive experiences that enhance clinical skill acquisition and student engagement. The review highlights that AR applications can bridge the gap between theoretical knowledge and practical training by providing realistic scenarios without compromising patient safety. Moreover, AR fosters critical thinking, confidence, and adaptability among nursing students, making it a promising complement to traditional teaching methods and virtual reality technologies in healthcare education (Buran-Omar and Mousa, 2022).

Despite the valuable contributions of prior reviews, a notable gap remains in the literature regarding the extent to which simulation-based learning (SBL) achieves its core objectives of knowledge and skills acquisition, as well as the retention of these competencies over time. Much of the existing evidence has emphasized learner confidence and satisfaction, while overlooking the durability of learning outcomes and the comparative effectiveness of different fidelity levels. This lack of comprehensive evaluation limits the ability of educators to make evidence-informed decisions about the optimal design and implementation of SBL in nursing education.

Aim of the study

Accordingly, the purpose of this systematic review is to examine the evidence on the effectiveness of virtual reality simulation (VRS) as an educational strategy in nursing, with a particular focus on four key learning outcomes: clinical skills, cognitive skills, satisfaction, and self-confidence among nursing students.

Review Question

Does the incorporation of virtual reality simulation into nursing education improve the educational learning outcome and clinical experiences of student nurses?

METHODOLOGY

Critical appraisal is the systematic evaluation of studies to determine their reliability, value, and relevance (Burls, 2014). It is vital for evidence-based practice, enabling healthcare professionals to apply research effectively by assessing internal validity, generalisability, and bias

(Morrison, 2017). Within systematic reviews (SRs), critical appraisal ensures that included studies meet eligibility criteria and undergo rigorous quality assessment. This process identifies methodological strengths and weaknesses, evaluates risk of bias in design and analysis, and eliminates irrelevant papers. Ultimately, findings from appraisal guide the synthesis and interpretation of SR results, strengthening the credibility of evidence (Averis and Pearson, 2003).

Inclusion and Exclusion Criteria

In systematic reviews, the establishment of inclusion and exclusion criteria is fundamental to ensuring methodological rigor and alignment with the study's objectives. Inclusion criteria refer to the specific features that determine which studies are eligible for analysis, thereby ensuring consistency and relevance to the research aim (Salkind, 2010). Conversely, exclusion criteria identify characteristics that disqualify studies from consideration, preventing the incorporation of sources that may compromise the validity of the review (Meline, 2006). Together, these criteria define the scope of the systematic review (SR) and reduce bias in the selection process (McDonagh et al., 2013).

For the present review, inclusion criteria were designed to capture the most recent and relevant evidence on virtual reality simulation (VRS) in nursing education. Following Parahoo's (2014) recommendation to adopt a defined time frame, studies published between January 2015 and January 2021 were considered. Eligible papers were limited to those published in English and focused specifically on nursing students, employing experimental designs such as randomized controlled trials (RCTs) and quasi-experimental studies. These criteria ensured that the review addressed the research question: *Does the incorporation of virtual reality simulation into nursing education improve the educational learning outcomes and clinical experiences of student nurses?*

The PICO framework guided the selection process. The Population (P) comprised nursing students enrolled in formal training programs. The Intervention (I) was the use of VRS, either as brief modules or integrated curriculum-based training. The Comparison (C) involved traditional teaching methods, such as manikin-based simulation, face-to-face clinical practice, or role play. The Outcomes (O) included primary outcomes—clinical and cognitive skill development—and secondary outcomes—student satisfaction and self-confidence, measured through validated scales and questionnaires.

Studies were excluded if they were published before 2015, written in languages other than English, focused on registered nurses or allied health professionals rather than nursing students, or employed non-quantitative designs. These exclusions ensured that the review remained tightly focused on the effectiveness of VRS in nursing education and avoided dilution of findings from less relevant or methodologically weaker sources.

Search Strategy: Keywords and Search Terms

Khan et al. (2003) emphasize the importance of conducting a comprehensive, well-structured, and clearly defined literature search within the systematic review (SR) process. Similarly, Bramer et al. (2018) note that the objective of a high-quality search is to identify a broad range of unbiased studies relevant to the chosen keywords. Achieving this requires an appropriate balance between sensitivity and specificity, while minimizing the risk of bias (Faggion Jr. et al., 2016; Bramer et al., 2018).

The initial stage of this review involved a scoping search using Google to identify the most relevant keywords, search terms, and suitable databases. This preliminary search included general teaching approaches in nursing education, alongside terminology describing various forms of virtual reality simulation (VRS) employed to enhance nursing students' skills. Based on these findings, the final search strategy incorporated terms related to experimental study designs, specifically randomized controlled trials (RCTs) and quasi-experimental studies, to ensure the inclusion of robust empirical evidence.

The search strategy incorporated a comprehensive set of keywords and MeSH terms to ensure the retrieval of relevant studies. Keywords included variations such as *nursing students*, *undergraduate nursing students*, *baccalaureate nursing students*, *pre-registration nursing students*, and *university nursing students*. To capture the intervention of interest, terms such as *virtual reality simulation*, *virtual training*, and the MeSH term *Virtual Reality* were employed. The population was further refined using the MeSH term *Nursing Students*. In addition, methodological filters were applied to identify studies with robust designs, specifically randomized controlled trials (RCTs) and quasi-experimental studies. This combination of keywords and controlled vocabulary was designed to maximize sensitivity while maintaining specificity, thereby ensuring that the search captured the most relevant evidence on the use of virtual reality simulation in nursing education.

Database Search: Electronic Searches

As part of the systematic search process, several relevant resources were identified. Five databases were considered most appropriate for retrieving literature related to nursing education and virtual reality simulation (VRS): PsycInfo, ERIC, Ovid MEDLINE, CINAHL, and ASSIA. These databases were selected for their comprehensive coverage of health sciences, psychology,

education, and applied social sciences, ensuring a broad yet focused scope of evidence.

The searches were conducted using Medical Subject Headings (MeSH) and related subheadings to refine and enhance the precision of results. In addition, keyword operators such as Boolean connectors and truncation symbols were employed to optimize sensitivity and specificity, thereby minimizing bias and maximizing the retrieval of relevant studies.

Searching Other Resources

In addition to database searches, supplementary strategies were employed to ensure comprehensive coverage of the literature. Reference lists and citations from studies that met the inclusion criteria were hand-searched to identify additional relevant publications. Furthermore, citation chaining was conducted to trace related works, thereby expanding the scope of potentially eligible studies. This process was complemented by targeted searches of academic websites and repositories, including Google Scholar, to capture grey literature and other sources that may not be indexed in traditional databases. Such supplementary searching enhances the completeness of systematic reviews and reduces the risk of omitting pertinent evidence.

Screening for Selection of Studies

The initial database search yielded 166 records, many of which were false positives. To prepare for screening and eligibility assessment, results were imported into Excel and duplicates removed. According to the Joanna Briggs Institute (2017), systematic reviews should involve at least two independent reviewers to ensure reliability in applying inclusion criteria, conducting appraisal, and extracting data (Porritt et al., 2014). Higgins and Altman (2008) caution that reliance on a single reviewer increases the risk of bias and reduces replicability. As this review was conducted by a single researcher, inter-rater reliability could not be achieved; however, screening and eligibility procedures were repeated to enhance accuracy. Screening was conducted in two stages: first, titles were examined to exclude studies with inappropriate methods, interventions, or populations; second, abstracts were assessed against inclusion and exclusion criteria. Eligible full-text articles were then retrieved for final evaluation. The absence of independent verification is acknowledged as a limitation.

Data Extraction

Data extraction was conducted systematically to ensure consistency and relevance to the review objectives. The findings chapter presents the extracted data in tabular form, summarising key study characteristics, participant details, and research outcomes. For each included study, the following information was recorded: author, year and country of publication, research design, intervention type, participant characteristics, data from experimental and control groups, outcomes examined, measurement tools employed, and results obtained. Statistical findings for each measured outcome were also documented to facilitate comparison across studies. The extraction and synthesis process followed the structured approach outlined by Boland (2017), incorporating table construction and narrative synthesis to provide a clear and comprehensive representation of the evidence base. This method ensured that the data were organised systematically, enabling meaningful analysis and interpretation in relation to the review's aims.

Data Analysis and Synthesis

Data synthesis provides a structured evaluation of the included studies, enabling the integration of findings and identification of inconsistencies across results (Collins and Fauser, 2005). In line with Munn et al. (2014), tables were employed to highlight key aspects of each study, facilitating effective comparison and reducing the risk of bias. Through this process, common themes and outcomes were identified, ensuring that the research question and aims remained central to the analysis. The synthesis aimed to generate summative evidence on the effectiveness of virtual reality simulation (VRS) in nursing education, particularly regarding its impact on clinical and cognitive skills, satisfaction, and self-confidence. The findings provide valuable insights for educators, programme designers, and researchers, offering guidance on current applications of VRS and informing the development of future studies and training initiatives in nursing education.

FINDINGS

Search Results

The study selection process and the number of records included and excluded are illustrated in the PRISMA flow diagram (Moher et al., 2009). The initial identification stage yielded 166 records, of which eight duplicates were removed, leaving 158 studies for screening. Titles and abstracts were then assessed against the predefined inclusion and exclusion criteria, resulting in 14 papers progressing to the eligibility stage. At this stage, six studies were excluded due to lack of alignment with the inclusion criteria, specifically in relation to study focus (n = 4), research design (n = 1), and population (n = 1). Consequently, eight studies met the eligibility require-

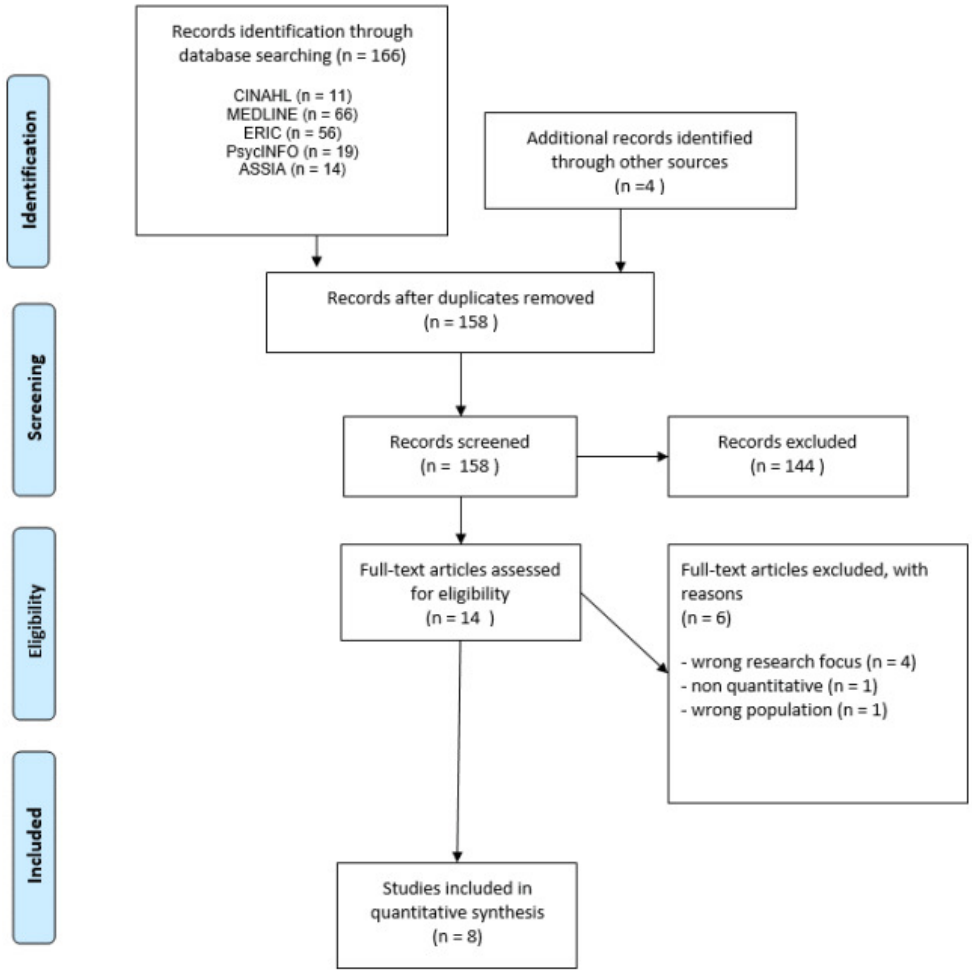

Figure 1. PRIZMA Flow Diagram

ments and were included in the final review. These studies were subsequently subjected to quality appraisal to evaluate methodological rigor and relevance to the research objectives.

Locations

The eight studies included in this review were conducted across six countries, reflecting a diverse geographical and cultural distribution. Specifically, the studies originated from Canada (n = 1), the United States (n = 3), Portugal (n = 1), Turkey (n = 1), Korea (n = 1), and Taiwan (n = 1). This international spread enhances the generalisability of the findings by incorporating evidence from varied educational and cultural contexts. Importantly, all studies were available in English translation, ensuring consistency in interpretation and analysis.

Participants

Across the eight included studies, a total of 507 under-graduate nursing students participated, with 256 in the experimental group and 251 in the control group. Only 12.3% of participants were male, reflecting a consistent gender imbalance across studies. This finding aligns with broader workforce trends, where males represent a minority in nursing—approximately 10.2% in the UK (Oxtoby, 2003), 9% in Canada (Statistics Canada, 2001), and 9.7% in the United States (American Association of Colleges of Nursing, 2006).

Key Findings

This systematic review examined four outcomes to assess the effectiveness of virtual reality simulation (VRS) in nursing education: clinical skills, cognitive skills (knowledge and retention), self-confidence, and satisfaction. Due to variability in study designs and outcome measures, meta-analysis was not feasible (Boland et al., 2017). Seven studies evaluated knowledge and retention, three assessed student satisfaction, and five measured self-confidence, with some using “self-efficacy” as a proxy predictor (Hajloo, 2014). Additionally,

five studies investigated clinical skills, focusing on competencies such as Foley catheter performance, psychomotor skills for decontamination and intravenous insertion, and clinical attitudes in chemotherapy scenarios. Collectively, these findings highlight VRS as a promising educational tool, though heterogeneity in methods and reporting limits generalisability.

Critical Appraisal

Each of the eight included studies was assessed using the appropriate JBI critical appraisal tools. Predetermined cut-off scores were set at 6/9 for quasi-experimental designs and 8/13 for randomized controlled trials (RCTs). Most studies met or exceeded these thresholds, including Smith et al. (2016), Farra et al. (2015), Padilha et al. (2019), Ismailoglu and Zaybak (2018), Yu et al. (2021), and Chan et al. (2021). Two studies fell below the cut-off (Cobbett and Snelgrove-Clarke, 2016; Smith and Hamilton, 2015) but were retained due to the limited pool of eligible research. Overall, methodological quality was judged to be satisfactory.

Effectiveness of VRS in Improving Clinical Skills

Five studies evaluated the impact of virtual reality simulation (VRS) on nursing students' clinical competencies compared with traditional methods such as lectures and mannequin-based training (Smith & Hamilton, 2015; Smith et al., 2016; Farra et al., 2015; Ismailoglu & Zaybak, 2018; Chan et al., 2021). Competence was assessed through tasks including Foley catheter placement, intravenous catheterisation, decontamination procedures, and chemotherapy administration. Three studies reported statistically significant improvements in skill performance with VRS, and one noted enhanced performance time. Conversely, two studies found no significant benefits, with Farra et al. (2015) highlighting technological issues that hindered effectiveness. Overall, VRS demonstrated potential but with mixed outcomes.

Effectiveness of VRS for Improving Cognitive Skills

Seven studies investigated the impact of virtual reality simulation (VRS) on nursing students' knowledge and retention (Cobbett and Snelgrove-Clarke, 2016; Smith et al., 2016; Farra et al., 2015; Padilha et al., 2019; Ismailoglu and Zaybak, 2018; Yu et al., 2021; Chan et al., 2021). Knowledge was typically assessed through written pre- and post-tests, measuring theoretical understanding of topics such as preeclampsia, decontamination, airway clearance, IV catheterisation, HirNIC, and chemotherapy administration. Four studies reported significant improvements in knowledge acquisition and retention with VRS, while three found no notable differences compared to traditional methods, indicating mixed but promising results.

Effectiveness of VRS on Satisfaction and Self-Confidence

Three studies (Padilha et al., 2019; Yu et al., 2021; Chan et al., 2021) reported statistically significant improvements in student satisfaction with VRS compared to traditional methods, with Padilha et al. (2019) and Chan et al. (2021) providing high-quality evidence supporting its effectiveness. Satisfaction is an important outcome, as it is linked to academic success (Ocker, 2001). In terms of self-confidence, five studies assessed VRS, but only Yu et al. (2021) demonstrated significant gains. The remaining studies found no notable differences compared to face-to-face training, indicating mixed evidence for this outcome.

DISCUSSION

Effectiveness of VRS on Satisfaction and Self-Confidence

Three studies (Padilha et al., 2019; Yu et al., 2021; Chan et al., 2021) reported statistically significant improvements in student satisfaction with VRS compared to traditional methods, with Padilha et al. (2019) and Chan et al. (2021) providing high-quality evidence supporting its effectiveness. Satisfaction is an important outcome, as it is linked to academic success (Ocker, 2001). In terms of self-confidence, five studies assessed VRS, but only Yu et al. (2021) demonstrated significant gains. The remaining studies found no notable differences compared to face-to-face training, indicating mixed evidence for this outcome.

Effectiveness of VRS in Nursing Education

This review assessed four domains: clinical skills, cognitive skills, satisfaction, and self-confidence. Of the eight included studies, three demonstrated significant improvements in clinical skills, four reported gains in cognitive outcomes, three showed enhanced satisfaction, and one indicated increased self-confidence. Overall, VRS appeared more effective in strengthening theoretical knowledge and retention than in improving clinical performance or confidence. Variability in study design, technological limitations, and differences in learning environments may explain these mixed results. Advances in VR technology, such as game-based systems with haptics, have shown promise in enhancing clinical

competence. While satisfaction outcomes were generally positive, evidence for self-confidence remains inconclusive. Collectively, findings suggest VRS contributes to knowledge acquisition and application, offering benefits comparable to conventional simulation methods.

Advantages and Disadvantages of VRS

Virtual reality simulation (VRS) offers several advantages in nursing education. It is accessible regardless of time or location, requires fewer resources than mannequin-based training, and is more cost-effective (Gu, 2017; Haerling, 2018). VRS also provides flexibility, enabling self-paced practice and reducing time constraints (Chang & Weiner, 2016). Students reported positive attitudes toward virtual environments, reflecting their familiarity with technology and motivation to learn through interactive platforms (Padilha et al., 2019; Yu et al., 2021; Chan et al., 2021). However, disadvantages include technological malfunctions, maintenance demands, and limited realism, which may hinder learning outcomes (Robinson & Dearmon, 2013). Many earlier studies highlighted these limitations, though advances in VR technology may now mitigate such issues. Further research is needed to evaluate the effectiveness of modern VRS in nursing education.

CONCLUSION

This review examined the effectiveness of virtual reality simulation (VRS) in nursing education across four learning outcomes: clinical skills, cognitive skills, satisfaction, and self-confidence. Evidence from eight studies suggests that VRS is particularly effective in enhancing knowledge acquisition and retention, with more limited but positive effects on clinical skills, satisfaction, and self-confidence. While traditional skill laboratories remain well-established in bridging theory and practice, VRS offers a developing alternative that may overcome some limitations of conventional simulation. However, findings on non-clinical outcomes remain inconclusive, and variability in study design and technology highlights the need for caution. Future research should employ high methodological quality and explore both the desirability and effectiveness of VRS to strengthen its role as an educational intervention in nursing.

REFERENCES

Al Gharibi KA, Arulappan J (2020). Repeated simulation experience on self-confidence, critical thinking, and competence of nurses and nursing students—An integrative review. SAGE Open Nurs. 6:2377960820927377.

Alharbi A, Nurfianti A, Mullen RF, McClure JD, Miller WH (2024). The effectiveness of simulation-based learning (SBL) on students' knowledge and skills in nursing programs: a systematic review. BMC Med Educ. Oct 7;24(1):1099. doi: 10.1186/s12909-024-06080-z.

American Association of Colleges of Nursing (2006). Advancing Higher Education in Nursing. Retrieved November 10, 2024 from http://www.aacn.nche.edu/2006AnnualReport.pdf

Averis A, Pearson A (2003). Filling the gaps: identifying nursing research priorities through the analysis of completed systematic reviews. Jbi Reports, 1(3), pp.49-126

Boland A, Cherry G, Dickson R. (Eds.) (2017). Doing a Systematic Review: A Student's Guide. Sage.

Bramer WM, de Jonge GB, Rethlefsen ML, Mast F, Kleijnen J (2018). A systematic approach to searching: an efficient and complete method to develop literature searches. J. Med. Lib. Assoc: JMLA, 106(4), p.531.

Brown JE. Graduate nurse's perspective of simulation to address the theory-practice gap in nursing. Walden University; 2018.

Buanz SF, Alsenayien AY, Altharman HA, Alnaqi RI, Llaguno MBB, Mousa O, Siraj RA (2024). Nursing students, faculty, and preceptors perception of effective characteristics of clinical instructor: A cross-sectional study. *SAGE Open Nursing, 10,* 1–8. https://doi.org/10.1177/23779608241298427

Buran-Omar AP, Mousa O (2022). Augmented reality application in nursing simulation: A review of its impact as educational support. *Int. J. Novel Res. Educ. Learn. 9*(6), 14–17. https://doi.org/10.5281/zenodo.7338765

Burls A (2014). What is critical appraisal?. Hayward Medical Communications.

Butler KW, Veltre DE, Brady D (2009). Implementation of active learning pedagogy comparing low-fidelity simulation versus high-fidelity simulation in pediatric nursing education. Clin Simul Nurs.;5(4):e129–36.

Cant RP, Cooper SJ (2017). Use of simulation-based learning in undergraduate nurse education: an umbrella systematic review. Nurse Educ Today. 49:63–71.

Chan HY, Chang HC, Huang TW (2021). Virtual reality teaching in chemotherapy administration: Randomised controlled trial. Journal of Clinical Nursing.

Chang TP, Weiner D (2016). Screen-based simulation and virtual reality for pediatric emergency medicine. Clinical Pediatric Emergency Medicine, 17(3), pp.224- 230.

Cobbett S, Snelgrove-Clarke E (2016). Virtual versus face-to-face clinical simulation in relation to student knowledge, anxiety, and self-confidence in maternal newborn nursing: A randomized controlled trial. Nurse Education Today, 45, pp.179- 184.

Collins JA, Fauser BC (2005). Balancing the strengths of systematic and narrative reviews.

Elcokany NM, Jaramillo J, Llaguno MBB, Seweid MM, Mousa O (2022). Student nurses as modern digital nomads: Developing nursing skills competence and confidence through video-based learning. *Int. J. Innov. Res. Med. Sci. 7*(11), 583–589. https://doi.org/10.23958/ijirms/vol07-i11/1536

Faggion Jr CM, Wu YC, Tu YK, Wasiak J (2016). Quality of search strategies reported in systematic reviews published in stereotactic radiosurgery. The Brit. J. Radiol. 89(1062), p.20150878.

Farra SL, Smith S, Gillespie GL, Nicely S, Ulrich DL, Hodgson E, French D (2015). Decontamination training: With and without virtual reality simulation. Advanced emergency nursing journal, 37(2), pp.125-133.

Gu Y, Zou Z, Chen X (2017). The Effects of vSIM for Nursing™ as a teaching strategy on fundamentals of nursing education in undergraduates. Clinical Simulation in Nursing, 13(4), pp.194-197.

Haerling KA (2018). Cost-utility analysis of virtual and mannequin-based simulation. Simulation in Healthcare, 13(1), pp.33-40.

Hajloo N (2014). Relationships between self-efficacy, self-esteem and procrastination in undergraduate psychology students. Iran. J. Psych. Behavioral Sci. 8(3), p.42.

Higgins JPT, Altman DG (2008). Assessing risk of bias in included studies.

Ismailoglu EG, Zaybak A (2018). Comparison of the effectiveness of a virtual simulator with a plastic arm model in teaching intravenous catheter insertion skills. CIN: Computers, Informatics, Nursing, 36(2), pp.98-105.

Joanna Briggs Institute (2017). Joanna Briggs Institute Reviewer's Manual. The Joanna Briggs Institute. Retrieved from https://reviewersmanual.joannabriggs.org/

Khan KS, Kunz R, Kleijnen J, Antes G (2003). Five steps to conducting a systematic review. J. Royal Soc. Med. 96(3), pp.118-121.

Labrague LJ, McEnroe-Petitte DM, Bowling AM, Nwafor CE, Tsaras K (2019). High-fidelity simulation and nursing students' anxiety and self-confidence: A systematic review. Nurs Forum. 54(3):358–68.

Massoth C, Röder H, Ohlenburg H, Hessler M, Zarbock A, Pöpping DM, et al. (2019). High-fidelity is not superior to low-fidelity simulation but leads to overconfidence in medical students. BMC Med Educ. 19:1–8.

McDonagh M, Peterson K, Raina P, Chang S, Shekelle P (2013). Avoiding bias in selecting studies. Methods Guide for Effectiveness and Comparative Effectiveness Reviews.

Meline T (2006). Selecting studies for systemic review: Inclusion and exclusion criteria. Contemporary issues in communication science and disorders, 33(Spring), pp.21-27.

Moher D, Liberati A, Tetzlaff J, Altman DG, Prisma Group (2009). Reprint— preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Physical therapy, 89(9), pp.873-880.

Morrison K (2017). Dissecting The Literature: The Importance Of Critical Appraisal Royal College Of Surgeons. [online] Royal College of Surgeons. Available at: https://www.rcseng.ac.uk/library-and-publications/library/blog/dissecting-theliterature-the-importance-of-critical-appraisal/

Munn Z, Tufanaru C, Aromataris E (2014). Data extraction and synthesis: The steps following study selection in a systematic review.

Munshi F, Lababidi H, Alyousef S (2015). Low-versus high-fidelity simulations in teaching and assessing clinical skills. J Taibah Univ Med Sci. 10(1):12–5.

Ocker RJ (2001). Collaborative learning environments: Exploring student attitudes and satisfaction in face-to-face and asynchronous computer conferencing settings. Journal of Interactive Learning Research, 12(4), pp.427-448.

Onda EL. Situated cognition: its relationship to simulation in nursing education. Clin Simul Nurs. 2012;8(7):e273–80.

Oxtoby K (2003). Men in nursing. Nursing Times, 99(32), pp.20-23.

Padilha JM, Machado PP, Ribeiro A, Ramos J, Costa P (2019). Clinical virtual simulation in nursing education: randomized controlled trial. J. Med. Internet Res. 21(3), p.e11529.

Parahoo K (2014). Nursing research: principles, process and issues. Macmillan International Higher Education.

Porritt K, Gomersall J, Lockwood C (2014). JBI's systematic reviews: study selection and critical appraisal. AJN The Ame. J. Nurs. 114(6), pp.47- 52.

Robinson BK, Dearmon V (2013). Evidence-based nursing education: Effective use of instructional design and simulated learning environments to enhance knowledge transfer in undergraduate nursing students. J. Profession. Nurs. 29(4), pp.203-209.

Salkind NJ. ed. (2010). Encyclopedia of research design (Vol. 1). sage.

Smith PC, Hamilton BK (2015). The effects of virtual reality simulation as a teaching strategy for skills preparation in nursing students. Clinical Simulation in Nursing, 11(1), pp.52-58.

Smith SJ, Farra S, Ulrich DL, Hodgson E, Nicely S, Matcham W (2016). Learning and retention using virtual reality in a decontamination simulation. Nursing education perspectives, 37(4), pp.210-214

Statistics Canada (2001). Education in Canada, 2000. Retrieved November 10, 2021, From http://dsp-psd.pwgsc.gc.ca/Collection-R/Statcan/81-229-XIB/0000081-229- XIB.pdf

Yu M, Yang M, Ku B, Mann JS (2021). Effects of Virtual Reality Simulation Program Regarding High-risk Neonatal Infection Control on Nursing Students. Asian Nursing Research.