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Fostering Critical Thinking Through Simulation: An Integrative Review

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The onset of the Next Generation NCLEX (NGN) has highlighted a greater need for learning modalities to teach new graduate nurses critical thinking or clinical reasoning skills. While pre-licensure baccalaureate nursing schools have aimed to impart these skills to students, the NGN focuses more on students' ability to interpret and use information rather than reciting facts (NGN, n.d.). This change to the licensure examination for nursing comes at a time when patients within the healthcare system are becoming sicker and experienced nurses are increasingly leaving the bedside due to retirement, non-patient facing roles, or non-clinical opportunities; this increase in acuity and a decrease in expert staff has become known as the experience-complexity gap (Delgado, 2020). A further complication is the increasing and persistent nursing shortage, leaving hospital systems needing nurse graduates who are prepared to quickly step into their roles as nurses and making nursing schools accountable for preparing nurse graduates for this task.

Critical thinking and clinical reasoning are essential to bedside nursing, a skill traditionally strengthened over time. Noll et al. (2023) describe critical thinking as the use of "knowledge that is based on evidence but not discipline specific" while clinical reasoning "requires evidence-based knowledge as it applies to a client problem using both cognitive and metacognitive processes" (p. 1). With the increased needs and changes at the hospital level, nursing programs have been charged with evolving their curriculum beyond the lecture format to more active or experiential designs in hopes of furthering critical thinking and clinical reasoning skill development. Simulation is one effective way for students to develop and practice critical thinking and clinical reasoning, because it requires applying knowledge; rather than merely verbalizing what should be done, the student must practice cognitive, psychomotor, and affective

skills to achieve it. This increasing need to develop critical thinking and clinical reasoning begs the question: How will undergraduate nursing students best learn this phenomenon?

Even though there is already a body of evidence about the influence that simulation has on critical thinking abilities, there are still a few areas that need more research. Despite the large body of knowledge on simulation, there is little on the comparison of different types of simulation and their effects on nursing students. With the NGN, it'll be important to know what form of simulation the best would be to build the clinical reasoning skills needed. This knowledge can help programs that have limited funds to invest in resources.

The extent to which the results may be generalized to other nursing groups, such as those in entry-level master's degree programs or associate degree programs, is not well recognized. It is essential to investigate the influence that simulation has on critical thinking abilities across a wider variety of nursing education contexts to establish whether or not the findings are consistent across a variety of educational programs and student groups. Further investigation is required because of the intricate interaction of the varying components that are involved in simulation-based learning and the cultivation of critical thinking. For the purpose of making improvements to the planning and execution of simulation experiences, a deeper comprehension of the connections that exist between student-related features, program characteristics, and simulation aspects is necessary.

Even though previous research has yielded useful insights, there is still a need for the development of best practices for the efficient design and execution of simulation-based learning to improve analytical reasoning abilities. The establishment of evidence-based recommendations for nurse educators will be aided by the determination of the optimal frequency and timing of simulations, the integration of feedback, and the inclusion of a variety of learning styles. Even

though research has been done to determine how manikin-based and virtual simulation affect critical thinking abilities in pre-licensure Bachelor of Science in Nursing (BSN) students, there are still major information gaps including which of these styles of simulation might be best and under what circumstances. In order to investigate the impacts over a longer period of time, apply the results to different nursing populations, decipher the intricate interactions that occur between the variables, and determine the most effective methods for the design and execution of simulation-based learning, further study is necessary. To improve our knowledge of how simulation may successfully nurture critical thinking abilities in nursing education, it is necessary to address the gaps that currently exist.

Background

With the increasing experience-complexity gap, nursing shortage, and changing standards at the entry to practice, the need for new nurse graduates to immediately be prepared to apply knowledge obtained in their courses is increasing. To best prepare students for these demands, schools of nursing need to use their time effectively with students, not only in building knowledge but also in skills to apply that knowledge, such as critical thinking. The problem is knowing whether virtual and manikin-based simulation will increase a participant's critical thinking ability. Due to the variety of meanings of some of the terms included in this problem, definitions were set by the appraisers for consistency. In this integrative review, virtual simulation is defined as a digital medium with which the participant interacts, such as augmented reality and computer-based simulations. (Foronda, 2021). Virtual reality or augmented reality simulations, which entails a three-dimensional, computer-generated interactional image or environment, are considered a developing form of simulation, while computer-based simulations can be more cost-effective due to the reduced needs for additional equipment (Bailey, 2020;

Foronda, 2021). Manikin-based simulation is any simulation in which the participant interacts with a manikin, whether low-, medium- or high-fidelity.

Simulation has been a long-standing educational tool used by multiple professions, including aviation, programming, and medicine. In nursing, simulation is ever evolving, from the invention of task trainers in the 1800s to interactive manikins in the 1960s to the virtual reality technology of today (History of Simulation, 2020). This learning modality has become standard practice in many academic institutions and hospitals. It allows for tactile skills, cognitive processes, and understanding of affective responses, all inside a safe and risk-free environment. After the landmark study by the National Council of State Boards of Nursing (NCSBN) showing that up to 50% of the clinical time could be replaced with simulation, the use and investment of simulation have increased, with one of the significant benefits being able to offer a consistent experience to all students unlike clinical experience (Hayden et al., 2014). However, since this publication by NCSBN, simulation has been evolving past manikin-based to virtual simulations.

Virtual simulation is a growing field, and with it comes some variation in the definition of what this form of simulation entails. In this integrative review, virtual simulation is any simulation in which the participant interacts with a computer-generated image either through a screen or other electronic equipment such as a helmet or gloves with sensors; this is one of the broader definitions in that it also includes computer-based simulations (Bailey, 2020). During the beginning of COVID-19, when clinical space became severely limited or unavailable, nursing schools incorporated virtual simulations into their programs using established or free online sources (Badowski et al., 2021).

Manikin-based simulation has been evolving over decades with the first fully automated manikin being developed in 2001 (History of Simulation, 2020). As this technology has been

advancing and becoming more accessible, it has opened opportunities in education that were not previously possible. With the NCSBN's decision to allow up to 50% of clinical time as simulation, nursing programs now can control some of the content their students see; clinicals cannot guarantee students witness certain disease processes (Hayden et al., 2014).

Studies about one or both forms of the simulation have examined the overall impact of manikin-based and virtual simulation. One issue highlighted by these studies has been the impact of COVID-19 on clinical and simulation education. When students were no longer allowed into hospitals, schools of nursing had to bolster their simulation programs. While manikin-based simulation has been standard, not all undergraduate programs had virtual simulation programs, which had to be implemented quickly (Badowski et al., 2021). Many studies directly comparing manikin-based versus virtual simulation compare well-established programs to more novel ones. These studies often focus on the impact on clinical reasoning of one or more simulation modalities to review the value of implementing manikin-based simulation or virtual simulation.

The incorporation of simulation-based learning into nursing education has recently attracted a lot of interest because of its potential to help pre-licensure BSN students strengthen their critical thinking abilities. Several research studies have investigated the effect that manikin-based simulation or virtual simulation have on the critical thinking skills of nursing students. These studies have provided useful insights into the possible advantages that may be gained from using these modalities. Despite this, there are still holes in our understanding and facets of the topic that need for more research.

Since both manikin-based and virtual simulation programs are available for BSN program to use and with the limited time for students to be in clinical and simulation, it is essential to know what modalities are best used to teach clinical reasoning. Determining the best

value of simulation comes down to which of the many styles and fidelity portends tremendous confidence and clinical reasoning skills. This integrative review examined the impact of manikin-based and virtual simulation in undergraduate nursing programs. More specifically, the research question that guided this integrative review was: In pre-licensure BSN students, do virtual simulation and manikin-based simulation increase critical thinking?

Methods

In conducting our integrative review, the framework put forth by Whittemore and Knafl (2005) was used to enhance data collection and interpretation. This framework comprises five stages: problem identification, literature search, data evaluation, data analysis, and presentation (Whittemore & Knafl, 2005). This methodology allows scholars to combine like studies and produce a comprehensive understanding of a specific subject matter. The initial stage of the research process entails the identification of the research problem and the subsequent formulation of a well-defined research question. Afterwards, a methodical exploration is undertaken to amass relevant research from diverse origins. The third step entails meticulously evaluating the qualities and relevance of the chosen studies. This appraisal process is conducted with great rigor to ensure the utmost accuracy and validity of the findings. Upon selecting the studies, the researchers extract and organize the data utilizing a pre-established coding scheme in the fourth phase. A thorough examination is conducted, amalgamating discoveries from various investigations to ascertain prevalent themes, trends, and deficiencies within the extant body of literature. Lastly, presentation is the building of new understanding; what are the implications based on the review. By implementing a prescribed set of five sequential procedures, researchers can proficiently execute an integrative review that enhances the progression of knowledge within their respective disciplines (Whittemore & Knafl, 2005).

In adherence with Whittemore and Knafl's (2005) framework, this integrative review's problem identification has been described in the Background section. The remaining four steps are discussed next.

Systematic Literature Search

After a collaborative effort of reviewing the research question and finalizing its foundation, the next step was to start a broad search of data for the sample of the integrative review. A sample search was completed through the research article databases provided by CINAHL and MEDLINE, through the Kennesaw State University library. Keywords used in this search included: simulations, International Nursing Association for Clinical Simulation and Learning, Computer Simulation, Virtual Reality, nursing students, student nurses, undergraduate student nurses, pre-licensure nurses, critical thinking, critical thinking skills, and clinical reasoning. The search parameters included the following: articles published in peer-reviewed scholarly journals, published within the last eight years (2015-2023), written in the English language and research studies. Only research studies were included in this integrative review, and peer reviewed journals were chosen to ensure a standard in quality of the study. Due to the complications from COVID-19 in nursing education, the year range was expanded from five years to eight. Full-text articles that were not available through the search were obtained through an interlibrary loan program when possible. Any other articles not available within the database or interlibrary loan program were excluded.

Both team members had access to a Microsoft Excel document containing the complete data matrix from independent searches. This enabled the researchers to collaborate successfully and recognize respective efforts in the integrative review process. To ensure the searches could be replicated, search parameters were agreed upon and outcomes entered into the Excel

document. The inclusion criteria included the following: (1) study participants must be undergraduate pre-licensure baccalaureate nursing students from traditional and accelerated programs, (2) must include manikin-based and/or virtual simulation, and (3) the study must address the effects of one or both types of simulation on critical thinking or clinical reasoning. Critical thinking and clinical reasoning are two different qualities, with clinical reasoning having a metacognitive component explicitly used for the clinical environment, compared to critical thinking which Noll et al. (2023) describe as evidence-based knowledge that is not tied to any specific discipline. A preliminary search of the literature revealed that many studies referred to critical thinking or clinical reasoning when assessing the application of knowledge by participants, and therefore the terms were reviewed as the same concept. Studies were excluded if they were programs that offered an associate or entry master's degree in nursing, if the article focus sample was on individuals who were already licensed registered nurses, or if a comparison with another modality of a teaching strategy was the focus or if the study did not evaluate the effects on critical thinking or clinical reasoning. The intent of specifying manikin-based simulation was to separate focus on the use of technology in simulation and its effect on critical thinking. Studies using standardized patients (SP) were only included if the SP was there to enhance the experience with the manikin or virtual simulation.

Data Evaluation

After completing the initial database search for samples, a total of 167 articles were identified based on the search criteria with one duplication. Progressing to the next step of screening were a total of 166 articles. Of the 166 sample articles from CINAHL and MEDLINE, 75 were excluded based on a failure to meet the search criteria from the titles, and 55 were excluded based on a failure to meet our search criteria from the abstract. Next, the appraisers

progressed to the inclusion steps; there were 36 articles remaining, of which 31 were excluded based on reading and eligibility of data presented. Of the five remaining articles, reference lists were reviewed producing 18 more articles for further consideration, in which eight were excluded due to lack of access to full text. Of the ten accessible articles, the abstracts were reviewed to determine if they matched our search criteria of keywords, publication date ranges, the geographical audience of research completed, and type of journal or article. Approved articles were thoroughly vetted through the same process and inclusion criteria of the initial articles, revealing one additional study. After being vetted in the secondary research, the selected article was entered in the Excel spreadsheet for data organization, maintenance, and updates of the selected sample as the review process continued. The final sample for this integrative review consisted of six articles. This review process is represented in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram in Appendix A.

The appraisers took the six articles in the final sample and used the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) model to review the evidence. This tool allows appraisers to evaluate the value of the study based on the level of the evidence (I-V, with I being the strongest level) and its quality (A-C, with A being the highest quality) (Johns Hopkins Health System/ Johns Hopkins School of Nursing, 2022).

Data Analysis

The methodical approach of choice for the analysis of information was thematic analysis. The six processes of thematic analysis, as described by Braun and Clarke (2006), include familiarization with the data, creating initial codes, searching for themes, looking over themes, defining and labeling themes, and producing the report. The studies included with their information and ratings can be found in Appendix B.

To shed light on the influence of manikin-based and virtual simulation on critical thinking abilities in pre-licensure BSN students, the goal of this thematic analysis was to recognize patterns and classify similarities that were present among the included research studies. In this integrative review, each of the appraisers were responsible for being well versed in the selected studies. Each appraiser conducted an independent examination of the articles, getting a thorough comprehension of each article's subject matter, research methodologies, and findings. The appraisers were able to acquire a contextual knowledge of the studies via the use of this procedure, which included becoming immersed in the relevant literature.

The appraisers started by developing the basic codes, including extracting meaningful units of data from inside the articles that were pertinent to the study issue that was being asked. Codes were created by identifying and classifying information. Each code generated was meant to indicate a certain feature or quality that might be deduced from the data as a feature relating simulation to the effect on critical thinking, see Appendix C. Following the completion of the preliminary coding, the appraisers met with an advisor who helped compare and refine the respective codes. This technique of working together with a third party revealed patterns and commonalities that were present throughout all of the research, resulting in a unanimous decision on the codes and the meanings of those codes.

After the codes were formed, the appraisers and advisor performed a secondary review for recurring trends. The study of the codes revealed several overarching patterns, which the appraisers have integrated into themes. To find higher-level ideas that represented the substance of the data, links, correlations, and common threads were tied into overarching concepts. The themes did not originate from any prior considerations, but rather arose naturally from the repeated similarities in the studies. As the process of analysis advanced, the appraisers revised

and improved the themes, consistently referring back to the studies. This iterative process of examining, revising, and returning to the themes continued until the researchers were able to come to a decision that was accepted by all of them.

Presentation

The final collection of themes reflected topics and findings that were linked between two or more of the studies. Each topic offered a conceptual framework for analyzing the aspects that affected the effect of simulation on critical thinking abilities in pre-licensure BSN students. This enabled the researchers to draw conclusions about the relationship between manikin-based and virtual simulation and the effect each plays on critical thinking. By redefining topics and narrowing down the themes of the literature, the appraisers were able to determine four themes in the sample; the themes noted during the data evaluation are the following: (1) the traits of the nursing program, (2) the traits of the simulation, (3) the traits of the student, and (4) the parallel outcomes, see Appendix D. No subthemes were identified.

Presentation of Findings

The aim of this integrative review was to determine if in pre-licensure BSN students, do virtual simulation and manikin-based simulation increase critical thinking. After using Whittemore and Knafl's (2005) framework for an integrative review, the appraisers narrowed down the literature to six studies. Information from the studies were examined and placed into a data matrix to include title, authors, year, method/design, sample size, level and quality, type of simulation and outcomes. The sample sizes of the studies ranged from 30-107 participants. The final six articles were comprised of one level I randomized controlled trial, three level II quasi-experimental and exploratory studies, and two level III longitudinal quantitative and qualitative

studies. There were five studies rated as being high quality (A) and one study rated as good quality (B). Five studies involved manikin-based simulation and three studies virtual simulation.

Theme one: Traits of the Nursing Program

One of the themes that impacted the increase in critical thinking was the traits of the nursing program offering the simulation. This characteristic of the nursing program was type of simulation program (novel versus established). Two articles in the final sample addressed this theme. Badowski et al. (2021) compared the use of manikin-based simulation and virtual simulation during COVID-19 when the ability for students to attend hospital clinics was limited, if not nonexistent. They noticed that the nursing programs that had established virtual simulation programs found a tremendous increase in knowledge and critical thinking compared to the novel programs (Badowski et al., 2021). Hwang and Lee (2021) also experienced no increase in knowledge or critical thinking during a newly implemented simulation to train students in disaster preparedness. The simulation was developed as a reaction to the onset of COVID-19, but with the unfamiliar content, the new program did not meet expected outcomes (Hwang & Lee, 2021). This begs the question of whether the experience and novelty of the program play into the student's ability to build critical thinking skills.

Theme two: Traits of the Simulation

A second theme identified was the traits of the simulation itself. Traits of the simulation included its method of simulation (manikin-based versus virtual), the content of the simulation as well as the construction or flow of the simulation (e.g., tiered acquisition). Five articles in the final sample addressed this theme. Manikin-based simulation and virtual simulation differ in the medium they use to deliver education and in some inherent traits, such as flexibility and context. Kaddoura et al. (2016) performed interviews with students who remarked that many features of

manikin-based or virtual simulation helped or hindered their critical thinking. Students embraced the flexibility of virtual simulation, which enables students to participate at their own speed and without the impression that they are being monitored, while the timely feedback of manikin-based simulation was considered a factor in the increase of critical thinking (Badowski et al., 2021; Everett-Thomas et al., 2021; Kaddoura et al., 2016).

Another trait of simulation that showed increased critical thinking was repetition. In studies where participants took part in multiple or repeated simulation, critical thinking scores increased and when participants were surveyed between these simulations, critical thinking increased between every stage (Guerrero et al., 2022; Kaddoura et al., 2016). Hwang and Lee (2021) discovered no increase in knowledge or critical thinking with progressing stages of the simulation; however, they also concluded that the content of the simulation may have been too advanced for the knowledge base of the participants. This suggests that while repeated simulations can foster increasing returns, limitations exist when the simulated content is beyond the knowledge base or too difficult for the learner. In the development of critical thinking, complexity of content in relation to the preparation of the participant has direct effect on the attainment of critical thinking skills. It has been shown that participating in learning activities that are based on simulations helps encourage active involvement, the addressing of problems, and the application of information in genuine clinical settings.

Theme three: Traits of the Student

The third theme identified was the traits of the student. These traits included their level in the nursing program and their personal characteristics such as openness, learning styles and preferences. Three articles in the final sample addressed this theme. Certain characteristics of the students can have an impact on developing critical thinking skills. A student's past experience

with simulation as well as their familiarity with the technology used in virtual simulation programs has an effect on the student's level of engagement and their capacity to apply critical thinking abilities. In the study by Hwang and Lee (2021), students did not show an increase in critical thinking; however, they had not had preparation or a learning experience similar to the simulation content. These students were in their second semester of nursing school and, with the complexity of the simulation, the students' experience and knowledge base may not have been an appropriate foundation for the simulation to develop enhanced skill. In addition to this, the significance of expanding one's knowledge base in connection to their critical thinking abilities has been brought to light. It has been shown that students who have a solid foundation of knowledge are better prepared to assess material, draw connections, and use critical thinking skills while participating in simulation exercises (Hwang & Lee, 2021). In comparison, Padilha et al. (2019) also used second semester students, but kept the simulation's focus on a single topic; students completed a virtual simulation on a respiratory topic which was meant to enhance what they had learned in class. This simulation lead to an increase in students' critical thinking skills. These studies suggest that a student's ability needs to be in line with the expectations of the simulation.

Students' levels of self-assurance and receptivity to the simulation experience were impacted, in a similar fashion, by the amount of assistance and direction that was offered by the instructors and facilitators. In general, the characteristics of the student played a big part in influencing the level of engagement they had during simulation-based learning as well as the critical thinking abilities they developed. The capacity of the students to evaluate information, think critically, and make well-informed judgments was impacted by a variety of factors,

including their prior knowledge, level of self-assurance, receptiveness, and personal preferences about learning.

Another characteristic that came to light was the students' openness to the opportunity to participate in the simulation. According to the findings of the research, active involvement and participation in the simulation exercises are quite important. Students that participated completely in the simulation, actively attempted to find solutions to problems, and showed an open mentality had a greater chance of developing and using critical thinking abilities (Kaddoura et al., 2016). On the other side, learners who are unengaged or who do not actively participate in the simulation may not get the full benefits from the experience, which might hinder the development of critical thinking skills. In addition, it was discovered that the unique learning styles and preferences of the students had an effect on their level of engagement and critical thinking when they were participating in the simulation (Hwang & Lee, 2021; Kaddoura et al., 2016). Some students may learn best via the hands-on and tactile experiences that are provided by manikin-based simulations, while others may find that the adaptability and immersive quality of virtual simulations better meet their needs. When these different preferences for learning are recognized and accommodated, it is possible to improve the quality of the educational experience and to speed up the maturation of critical thinking abilities.

Theme four: Parallel Outcomes

A fourth theme identified was parallel outcomes in the simulation. This includes the correlations and/or possible causation of other found attributes of the simulation outcomes. These are variables and other outcomes that were measured as a part of the simulation that had a strong correlation with the development of critical thinking and are possible pre-cursers to the acquisition of critical thinking. There were five articles in the final sample that addressed this

theme. One interesting correlation with increased critical thinking is the increase of knowledge. In most of the studies, when knowledge scores increased for the participants, so did the critical thinking scores (Badowski et al., 2021; Everett-Thomas et al., 2021; Guerrero et al., 2022; Kaddoura et al., 2016; Padilha et al., 2019). In only one study did the researchers find no increase in critical thinking scores with simulation; however, they also found no increase in knowledge (Hwang & Lee, 2021). Confidence was also a trait that most of the studies surveyed; however, the results varied with some studies showing a direct relationship between self-efficacy and critical thinking (Badowski et al., 2021; Everett-Thomas et al., 2021; Guerrero et al., 2022; Kaddoura et al., 2016) and others showing no correlation (Padilha et al., 2019). This is interesting as critical thinking and self-efficacy are often considered to be relational to one another (Billings & Halstead, 2020). The parallel outcomes of the simulation emerged as a recurrent topic in the process of comprehending the influence that manikin-based and virtual simulation has on the capabilities of critical thinking. The analysis of the studies indicated various elements connected to the other simulation outcomes were associated with the development of critical thinking. A foundation of pre-simulation knowledge was recognized as being an important characteristic of the development of critical thinking (Hwang & Lee, 2021). The investigations all came to the same conclusion: having more information was directly related to having better analytical and deductive reasoning abilities. Students were better able to evaluate information, create connections, and use critical thinking skills as their grasp of the subject matter increased and they gained a deeper comprehension of the material (Badowski et al., 2021; Everett-Thomas et al., 2021; Guerrero et al., 2022; Hwang & Lee, 2021; Kaddoura et al., 2016; Padilha et al., 2019).

Discussion

The purpose of this integrative review was to investigate the effect that manikin-based simulation and virtual simulation had on the critical thinking abilities of pre-licensure BSN students. The analysis of the included studies uncovered several significant themes, which are as follows: the traits of the nursing program, the traits of the simulation, the traits of the student, and the parallel outcomes. These themes each represent features of simulation that may contribute to how simulation produces increases in critical thinking. Established virtual simulation systems demonstrated a much greater growth in knowledge and critical thinking when compared to novel programs, which was one of the most important discoveries made about the characteristics of the program (Badowski et al., 2021). This leads one to believe that the efficiency of simulation-based learning is influenced not only by prior experience but also by the accessibility of tools and assistance. Students praised the adaptability of the virtual simulations, which gave them the opportunity to participate in the activities at their own speed and shielded them from the impression that they were being watched. It was also shown that receiving feedback in a timely manner, a feature of manikin-based simulation, was an essential component in improving one's critical thinking abilities.

The traits of the simulation played a part in shaping critical thinking as well. Studies showed that participants' level of critical thinking improved with each successive stage or repetition of the simulation (Everett et al., 2021; Kaddoura et al., 2016). Contrary to what previous studies have found Hwang and Lee (2021) didn't show any progress in knowledge or critical thinking using simulations. There could be reasons for this disparity. The complexity of the simulation content might have overwhelmed the students making it challenging for them to apply reasoning skills especially if the material was too advanced for their level of understanding. Insufficient preparation beforehand could have also left the students struggling

with concepts hindering their ability to engage in higher order thinking. Furthermore, the novelty of the simulation experience, having been newly created, can be overwhelming, causing students to react rather than think critically. This study highlights how important it is to tailor simulations to match learners' expertise levels ensuring that the complexity of the content aligns with their readiness and emphasizing the need for feedback. While Hwang and Lee's (2021) findings may seem unusual compared to others, they serve as an example; merely incorporating simulations doesn't guarantee improved thinking; careful design and execution are equally crucial.

The degree of expertise of the participants should be considered while designing the simulation's content and level of difficulty to get the most benefit. The traits of the student were also a factor in the influence that the simulation had on their ability to think critically. Looking at the studies, there is a correlation between having more information and having stronger critical thinking abilities (Everett-Thomas et al., 2021; Hwang & Lee, 2021; Kaddoura et al., 2016). This exemplifies the dynamic relationship that exists between the capacity to acquire information and think critically; the symbiotic relationship of classroom and practice. In addition, the association between self-efficacy and critical thinking was inconsistent, with some research finding a positive correlation between the two (Badowski et al., 2021; Everett-Thomas et al., 2021; Guerrero et al., 2022; Kaddoura et al., 2016), but other studies showing no meaningful relationship between the two (Padilha et al., 2019). To fully comprehend the intricate web of relationships that exists between self-efficacy, knowledge and critical thinking, further research is required. These studies included many factors that were seen in multiple studies, such as the use of timely feedback, the alignment of simulation material with the experience of the participant, the repeating of simulations, and the improvement in one's level of knowledge. When educators and program creators have a better understanding of these characteristics, they may be

better equipped to optimize simulation-based learning experiences to improve students' critical thinking abilities.

Given the increasing need for improved critical thinking skills among new graduate nurses and the challenges faced by an aging nursing workforce this integrative review recognized the need to develop educational opportunities to better prepare undergraduate BSN nurses for their role at the bedside. With the experience-complexity gap, it is becoming more and more the responsibility of the academic nursing institution to build a strong foundation of critical thinking skill (Delgado, 2020). Our findings highlighted the advantages of both manikin-based simulations and virtual simulation in the acquisition of critical thinking. Virtual simulations offer flexibility and the ability to learn at the learner's pace while manikin-based simulations provide real time feedback, communication and group dynamic. While previous research hinted at the benefits of simulation, our review enhances an understanding of how simulation may lead to increased critical thinking. Virtual or manikin-based simulation may be more appropriate or convenient; however, our study depicted the efficacy of them both to enhance critical thinking and therefore acknowledges that the institution should look at implementation based on its needs and resources. It is important to note that the effectiveness of simulation varies depending on program characteristics and individual student traits. We also discovered that theoretical knowledge and practical application are closely intertwined, which suggests a phased integration of simulation into nursing curricula. This has implications for nursing practice including the need for curriculum design using personalized learning plans, ongoing professional development through simulations, and policy changes to promote use of simulation. Ultimately by incorporating simulation-based learning the nursing profession can develop thinking professionals who are well equipped to tackle the complex demands of modern healthcare.

Limitations

It is essential to recognize that this integrative review contains substantial limitations. This review did not look at the grey literature but only peer-reviewed studies which may have limited the materials found. Our review also only looked at pre-licensure BSN students, which makes it difficult to generalize the results to other types of nursing students or demographics. The evidence base in this area needs to be strengthened by doing further research with nursing populations that are more diverse and using bigger sample sizes. The results of this integrative review indicate that manikin-based simulation and virtual simulation both can develop critical thinking abilities in pre-licensure BSN students; however, with the limited number of studies and only two comparing the manikin-based versus virtual simulation, this shows the need for more studies comparing the two. This is important considering that schools of nursing have limited time and resources, and it would be beneficial for them to know what modalities will work best. Many of these studies took place during the height of the COVID-19 pandemic which could have limited the studies available since studies and publication were not at the forefront and also swayed the outcomes due to the immeasurable variables that came into play in 2020.

Implications for Education

The ever-changing health landscape has been dramatically altered in the last three years, and nursing education stagnated in a time when nurses were needed the most. While there were no comparable precedents in recent history, building simulation programs that are effective, established and evidence-based became an evident need for the future of nursing education. While there are many studies comparing simulation to other forms of learning, there is little evidence comparing different uses of simulation to each other or its use among different populations within undergraduate nursing education. This would be beneficial to help discern

and differentiate between manikin-based and virtual simulation and give more direction for institutions unable to maintain both forms of simulation. Educators and program developers should take into account student base knowledge while planning and implementing simulation-based learning experiences to increase critical thinking abilities in pre-licensure BSN students.

Building a larger body of knowledge on this subject would be helpful in rural areas where clinical sites are difficult to come by and simulation may be the only viable option. This would allow schools to adequately assess their needs and use the methods that appropriately train their students. It would also be prudent to repeat the NCBSN survey on simulation to include the different means of simulation as well as increasing the percentage of simulation to clinical measured (Hayden, 2014). This study may be better able to evaluate the method of simulation used to replace clinical in environments where specialty clinical is not practical or in times like COVID-19 when the hospitals are not available as learning environments.

Implications for Research

This study highlights the correlation among knowledge, self-efficacy and critical thinking. Future research is needed to look into these relationships. By understanding how the development of these three skills relate to one another could help guide future practice; if self-efficacy is more than directly correlated, but in fact essential to the development of critical thinking, then education may need to adjust to build confidence to increase critical thinking skills.

Future studies should also look at the differences in critical thinking based on different levels within the nursing program. Based on the growth of foundational knowledge, there may be documentable differences in the abilities of nursing students to develop critical thinking skills based on their semester of study. This research can help educators as they create simulation

activities to understand when in the nursing school curriculum would be most effective to implement simulations. Performing studies with a greater number of participants can help expand the generalizability of the results.

Implications for Practice

Our review highlights the importance of thinking. The themes described underscore the need for curriculum development that incorporates manikin-based and virtual simulations in pursuit of enhanced critical thinking. Simulations should be tailored to students' knowledge, learning preferences, and stages in the nursing program, ensuring an approach that enhances thinking skills during each simulation; just as skills and knowledge become more complex, so should thinking. Furthermore, instructors play a role in this evolving landscape. They should receive training and support to effectively guide students in reflective thinking during simulations. This requires expertise in simulation tools as the ability to teach students how to think critically and reason clinically.

Additionally, simulations should include mechanisms for providing feedback and assessing student performance to facilitate learning and enhance thinking. This allows students to reflect on their actions and thoughts. To fully understand the long-term impact of simulation on thinking abilities and its therapeutic application, longitudinal studies are necessary. Such studies will shed light on how simulation-based learning can optimize term clinical reasoning skills and decision-making abilities. Lastly, ensuring the distribution of resources is essential for achieving these goals. In situations where resources are limited, it is important to support both manikin-based and virtual simulations. Offering both forms of simulation can expand accessibility to all students, regardless of their location or school. Simulation nursing educators need to continuously update their professional development in order to stay up to date with the latest

strategies and technology. By doing so, they can effectively guide students in dynamic learning environments.

Creating a learning environment where students can learn from each other and reflect on their experiences enhances the effectiveness of simulations. This kind of atmosphere fosters better learning outcomes and helps students develop the thinking skills needed to tackle the challenges of modern healthcare. These methods highlight how simulation can enhance thinking in nursing education. By utilizing these approaches, nursing education can adapt to healthcare demands and successfully teach nurses the importance of critical thinking.

Implications for Policy

With the advent of COVID-19, many programs of nursing ceased clinical in the hospital setting and had to find alternate ways to provide clinical experience for students (Badowski et al., 2021). While COVID-19 was far more severe than anyone could have imagined, it has shown that schools of nursing need to be well prepared for the unexpected. While simulation is not required for certification of nursing programs, it seems only prudent that schools of nursing prepare a back-up for clinical should they be unable to practice in the hospital setting. This could be a change in requirements for nursing programs to either engage in simulation or have plans to quickly implement simulations when in-person clinical is impossible. This would be beneficial to students, to prevent a gap in their education, but would also benefit faculty and staff in that they would be prepared for the adjustments instead of trying to plan, develop and implement in a limited timeframe.

Conclusion

In conclusion, these findings show that virtual simulation is comparable to manikin-based simulation, but each has different benefits. The necessity of having a strong knowledge base as

the basis for good critical thinking is brought into focus by this discovery. Additionally investigated as characteristics of the student were their levels of self-assurance and self-efficacy. Some research discovered a good association between self-efficacy and critical thinking abilities (Badowski et al., 2021; Everett-Thomas et al., 2021; Guerrero et al., 2022; Kaddoura et al., 2016), whereas other investigations failed to find a meaningful relationship between the two factors (Padilha et al., 2019). This lends credence to the idea that the effect of confidence and self-efficacy on critical thinking may be multifaceted and subject to the influence of a variety of circumstances. Hwang and Lee (2021) provided a good example on the need for knowledge foundation before the simulation experience. In the context of simulation-based learning, further study is required to develop a deeper understanding of the dynamic relationships that exist among self-efficacy, confidence, and critical thinking. However, the efficiency of learning via simulation is contingent on several elements, that have been mentioned herein. When planning and executing simulation-based learning experiences for nursing students, educators and program developers should keep these considerations in mind; these experiences are intended to improve critical thinking and clinical reasoning abilities through controlled scenarios. There is a need for more study to investigate the long-term effects that simulation has on critical thinking and the extent to which it may be transferred to clinical practice.

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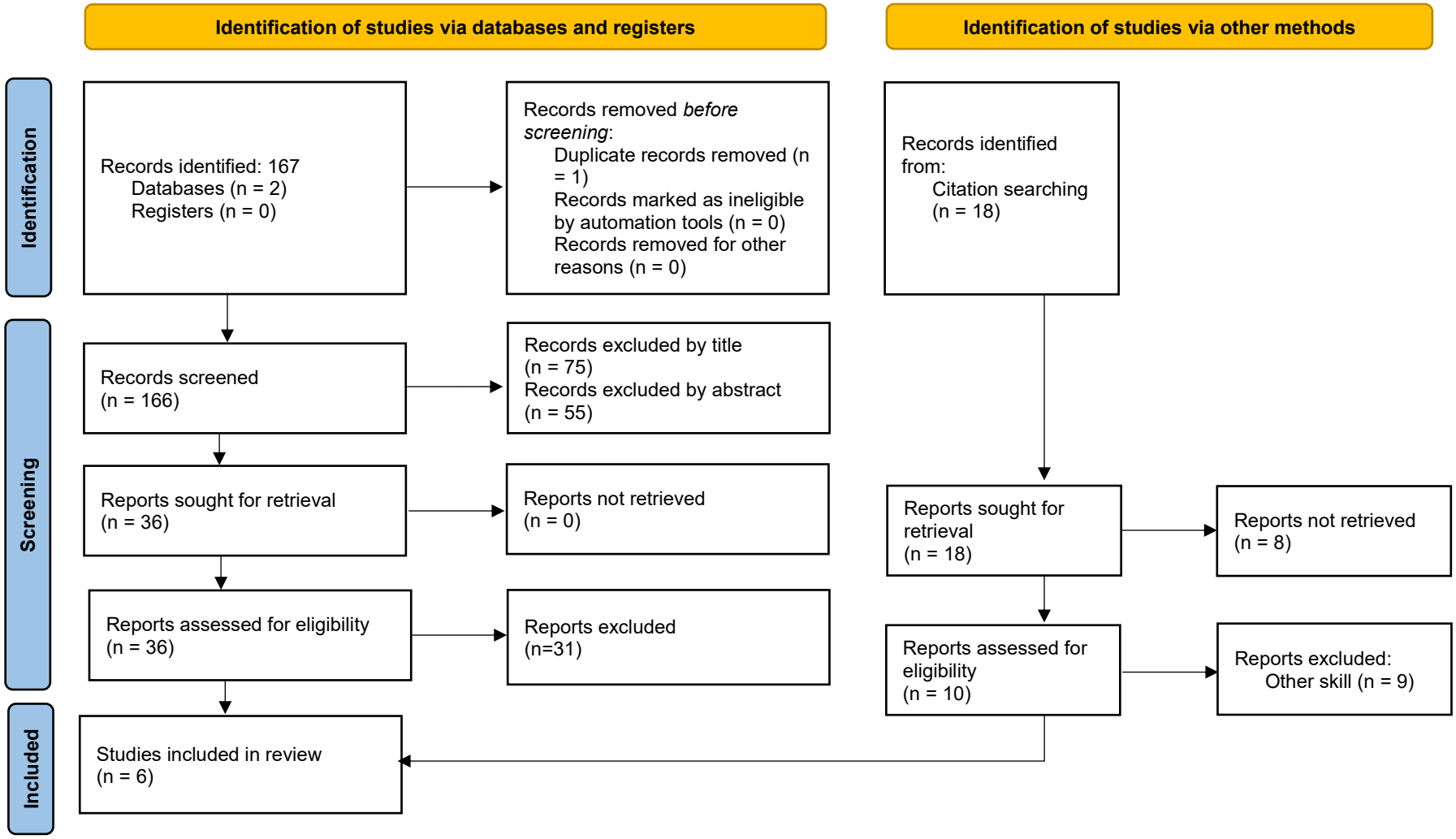
Appendix A: PRISMA Flow Diagram



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

Appendix B: Summary of Literature Review – Data Matrix

VS = Virtual Simulation

MBS = Manikin-based Simulation

LF = Low-Fidelity

Title	Authors	Year	Method/ Design	Sample Size	Level & Quality Rating	Type of Simulation	Outcomes
Exploring student perceptions of virtual simulation versus traditional clinical and manikin-based simulation	Badowski, D., Rossler, K. L., & Reiland, N.	2021	retrospective multi-site exploratory, descriptive study	45 nursing students	II A	MBS/VS	This study showed an increase in critical thinking through the use of virtual simulation but saw a greater improvement with the use of both manikin-based simulation and virtual simulation.
Using virtual simulation and electronic health records to assess student nurses' documentation and critical thinking skills.	Everett-Thomas, R., Joseph, L., & Trujillo, G	2021	quantitative longitudinal research design	84 first semester nursing students	III A	VS	Using VS increased both knowledge and critical thinking skills of all students. No control group was used, but significant improvement was shown from pre-test to post-test.
The Acquired Critical Thinking Skills, Satisfaction, and Self Confidence of Nursing Students and Staff Nurses through High-fidelity Simulation Experience.	Guerrero, J. G., Ali, S. A. A., & Attallah, D. M.	2022	Quasi-Experimental	30 nursing students	II B	MBS	While this study compared nursing students and their response to high fidelity simulation as compared to working nurses, there were some good discoveries. Of the student nurses, there was an increase in the application of knowledge of nursing students leading to increased clinical reasoning. There were

							also high satisfaction level for students after simulation.
Perceived benefits and challenges of repeated exposure to high fidelity simulation experiences of first-degree accelerated bachelor nursing students.	Kaddoura, M., Vandyke, O., Smallwood, C., & Gonzalez, K. M.	2016	Exploratory qualitative design	107 first semester Senior nursing students	III A	MBS	Students participated in one day of multiple MBSs, leading to increases in multiple attributes including critical thinking
Effectiveness of the Infectious Disease (COVID-19) Simulation Module Program on Nursing Students: Disaster Nursing Scenarios.	Hwang, W. & Lee, J.	2021	Quasi-Experimental	78 nursing students	II A	MBS	Students participated in a three-tiered simulation on disaster preparedness. While disaster preparedness and willingness to intervene were increased, there was no increase in critical thinking, knowledge or self-confidence.
Clinical Virtual Simulation in Nursing Education: Randomized Controlled Trial.	Padilha, J. M., Machado, P. P., Ribeiro, A., Ramos, J., & Costa, P.	2019	Randomized Controlled Trial	42 second year nursing students	I A	MBS-LF/VS	Students were compared between a low-fidelity simulation and virtual simulation. The virtual simulation group had a greater increase in critical thinking, knowledge and satisfaction, but no difference in self-efficacy or knowledge retention over time.

Appendix C: Article Coding

Title	Surveyor 1	Surveyor 2
Exploring student perceptions of virtual simulation versus traditional clinical and manikin-based simulation	COVID-19 on Nursing Education Compare of Learning Environments Perceived Learning Needs Traditional Clinical Experiences Shift to Remote Learning Learning Modalities	Learning application Meeting learners' needs Teaching-Learning Dyad Self-efficacy Semester of Study Comfort with Technology Previous Degrees Learner Reactions Timely Feedback Safe Environment Previous VS/MB use Learner satisfaction Program establishment/novelty
Using virtual simulation and electronic health records to assess student nurses' documentation and critical thinking skills.	Clinical Documentation Critical Thinking Skills Benner's Novice to Expert Theory Student Performance Progression Readiness for Clinical Practice Virtual Patients	Comfort with technology Year of study Self-guided Repetition Previous experience (non-nursing degrees) Feedback Tech experience of educators
The Acquired Critical Thinking Skills, Satisfaction, and Self Confidence of Nursing Students and Staff Nurses through High-fidelity Simulation Experience.	Self-Confidence in Nursing Acquired Critical Thinking Skills Self-Confidence in HFS Learning Retention of Learning Nursing Students and Staff Nurses Competency Advancement with HFS	Self-confidence satisfaction repetition Previous Simulation exposure Enhanced Judgement
Perceived benefits and challenges of repeated exposure to high fidelity simulation experiences of first-degree accelerated bachelor nursing students.	Gap in Existing Literature Views of First-Degree BSN Students Positive Outcomes to Complex Sim Feeling Overwhelmed	Cost-effective Application No previous degrees Repetition Clinical Judgement

	Generalizable to other Fields Challenges of Exposure to Many HFS	Learning from Mistakes Integrating Knowledge Revel gaps in practice Being watched Contextual factors Highlights deficits Anxiety
Effectiveness of the Infectious Disease (COVID-19) Simulation Module Program on Nursing Students: Disaster Nursing Scenarios.	Significance of Debriefing/Serial Test Increased Confidence/ Participation Areas for Further Improvement Need for Further Studies Future of Virtual Reality Simulation Jeffries Simulation Model	Willingness to participate Confidence Knowledge Competency Sense of responsibility Time investment repetition Level of experience Engagement
Clinical Virtual Simulation in Nursing Education: Randomized Controlled Trial.	Knowledge and Clinical Reasoning Professors and Learning Facilitators Knowledge Retention Higher Satisfaction Self-Efficacy Perceptions Virtual Simulation as a Strategy	Cost Space Pre-, Post-. 2 month follow-up Knowledge Satisfaction Knowledge retention Self-efficacy

Appendix D: Article Themes

Themes	Relevant Articles
Theme one: Traits of the Nursing Program	Exploring student perceptions of virtual simulation versus traditional clinical and manikin-based simulation Effectiveness of the Infectious Disease (COVID-19) Simulation Module Program on Nursing Students: Disaster Nursing Scenarios.
Theme two: Traits of the Simulation	Exploring student perceptions of virtual simulation versus traditional clinical and manikin-based simulation The Acquired Critical Thinking Skills, Satisfaction, and Self Confidence of Nursing Students and Staff Nurses through High-fidelity Simulation Experience. Perceived benefits and challenges of repeated exposure to high fidelity simulation experiences of first-degree accelerated bachelor nursing students. Effectiveness of the Infectious Disease (COVID-19) Simulation Module Program on Nursing Students: Disaster Nursing Scenarios. Using virtual simulation and electronic health records to assess student nurses' documentation and critical thinking skills.
Theme three: Traits of the Student	Effectiveness of the Infectious Disease (COVID-19) Simulation Module Program on Nursing Students: Disaster Nursing Scenarios. Perceived benefits and challenges of repeated exposure to high fidelity simulation experiences of first-degree accelerated bachelor nursing students. Clinical Virtual Simulation in Nursing Education: Randomized Controlled Trial.
Theme four: Parallel Outcomes	Exploring student perceptions of virtual simulation versus traditional clinical and manikin-based simulation. Using virtual simulation and electronic health records to assess student nurses' documentation and critical thinking skills. The Acquired Critical Thinking Skills, Satisfaction, and Self Confidence of Nursing Students and Staff Nurses through High-fidelity Simulation Experience. Perceived benefits and challenges of repeated exposure to high fidelity simulation experiences of first-degree accelerated bachelor nursing students. Clinical Virtual Simulation in Nursing Education: Randomized Controlled Trial.