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The Impact of Simulation Education on Self-Efficacy in Pre-Registration Nursing Students

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Abstract

This literature review primarily aims to explore and synthesise the previous studies in simulation education research conducted over the past five years related to the effects of simulation training on the self-efficacy of undergraduate pre-registration nursing students. The second aim of this study is to explore additional outcome variables that were examined in the previous studies. Five electronic databases were searched systematically. These databases were MEDLINE, CINAHL Plus, Scopus, Embase and PsycINFO. The PICO model was employed to identify the search terms, with a thesaurus being used to provide synonyms. Reference lists of relevant articles were examined and hand searches of journals were also undertaken. The quality of each study was assessed using the Simulation Research Rubric (SRR). A total of 11 studies were included. All studies explored the impact of simulation education on undergraduate pre-registration nursing. Six studies explored nursing students' competence and performance and two papers examined their critical thinking. Problem solving, learning motivation, communication skills and knowledge acquisition were examined once. The majority of studies indicated that simulation training has a positive impact on pre-registration nursing students' self-efficacy and other outcome variables. Furthermore, the study results indicate that simulation training is more dependable than traditional training, and students were extremely satisfied with the simulation training. However, most of the studies included in this review had several gaps, including study design, sample size and dissimilarities between the scales used.

Further research with large samples, reliable and valid instruments, and outcomes measures (such as critical thinking and transferability of skills) is required to provide better insight into the effectiveness of simulation in undergraduate nursing education.

Keywords

Simulation Education, Self-Efficacy, Pre-Registration Nursing Students, Clinical Skills, Undergraduate Nursing Education, Teaching Techniques, Decision-Making

1. Background

In the globalization era, education plays a crucial role. Education is experiencing increasing competition. Thus, universities and colleges need to add value to compete with one another and win the competition. To accomplish this objective, they must increase their abilities to meet society's expectations regarding formal education [1]. However, nursing education involves clinical instruction as well as classroom lectures, and the ultimate objective is to help students apply the knowledge they have acquired in the classroom to clinical practice. Consequently, facilitators must provide sufficient clinical experience to students [2]. Due to the short duration of clinical placements, however, students are limited in their opportunities to obtain clinical experience with real patients [3]. In simulation-based clinical education, nursing students are given real-life situational experiences and are given an opportunity to practice their clinical and decision-making skills without detriment to the patient's wellbeing [4].

The Nursing and Midwifery Council (NMC) announced in 2007 that simulated educational opportunities have been integrated into more than 40 pre-registration undergraduate nursing education programmes in the United Kingdom. The mandatory 2300 direct clinical hours of practice can be completed by completing a maximum of 300 hours of simulated practice, which will be carried out in a designated simulated learning environment [5]. It was further explained by NMC in 2007 that simulation could not substitute clinical practice, but rather could complement it, and that simulation within the confines of a designated clinical training suite or a clinical laboratory setting provided a controlled environment in which clinical skills may be enhanced [5]. Recently, as a result of ongoing clinical practice constraints caused by the onset of the COVID-19 pandemic in 2021, the NMC has announced details of an updated policy to support nursing students in achieving the required competencies for registration [6]. All nursing students who are studying at an approved education institution will be able to substitute up to 300 hours of clinical practice with simulation activities [6]. Therefore, simulation has a significant role to play in nursing education.

Simulation is an evidence-based teaching and learning method that replicates

actual situations, thus allowing trainees to implement skills and gain knowledge actively [7]. It is a teaching technique that allows students to experience the real dimensions of future work in a professional capacity; consequently, they can be more rapidly assimilated into the human resources of the health care sector [8]. Simulation is commonplace in nurse training and entails students using knowledge and applying skills in well-coordinated and monitored environments to get constructive feedback [9]. Students repeat tasks often and get immediate feedback to further improve the skills necessary to deliver patient care effectively. Pre-clinical simulated patient scenarios effectively identify students' capacity to make decisions and use skills; it also arouses their learning commitment and motivation [10]. Moreover, simulation helps students improve their motor skills and perform tasks intuitively [11].

Simulation education became important in nursing education as there was a noticeable lack of coordination between theory and practice. The disconnection between theory and reality makes learning difficult, and poor knowledge of nursing terminologies and concepts impact professional integration [8]. Therefore, simulation becomes the solution to the challenge of difficulties in practically implementing theoretical knowledge, as nursing theory is harmoniously linked to practical skills [8]. The simulation presents opportunities for nurses to improve their abilities and skills, as both rare and frequent clinical events can be replicated realistically as often as needed [9]. In addition, students can commit every possible error without harming actual patients [9] [12]. Simulation is applied as a replicable teaching tool to teach university nursing students about patient care.

Applying clinical skills enhances self-efficacy. Self-efficacy helps students convert the informational content acquired in the simulation scenarios to actual care settings [13]. Bandura's [14] social cognitive theory identifies self-efficacy as the belief in self to execute the approaches needed to achieve anticipated goals. As nurse students practice through simulation and get constructive feedback, they acquire experience and enhance decision-making to achieve higher expert levels [15]. High self-efficacy is associated with a stronger commitment for nurses to use their clinical skills, meet their clinical objectives and overcome challenging situations more easily [16]. Proficiency in novel skills and experiencing victory during performance greatly influence self-efficacy.

The self-efficacy theory ascertains that the dynamics that affect behaviour are rooted in the conviction that the person can achieve that behaviour [17]. Individuals will choose to partake in activities in which they are sure they can succeed and will avoid those in which they may fail. Confidence is crucial in nursing school, where learning relies on overcoming various doubt-propagating motivational, social and intellectual encounters [17]. Subsequently, studies on the perceptions of self-efficacy among health professional students propagate knowledge about their choices, persistence, efforts and ability to improve instructional practice [18].

2. Aim, Objectives and Research Questions

This literature review primarily aims to explore and synthesise the studies in simulation education research conducted over the past five years related to the effects of simulation training on the self-efficacy of undergraduate pre-registration nursing students. The second aim of this study is to explore additional outcome variables that were examined with self-efficacy in the previous studies.

The current review is designed to address three research questions:

1) Does simulation education positively influence the self-efficacy of pre-registration nursing students?

2) How useful is simulation education compared to other teaching methods to instruct undergraduate pre-registration nursing students?

3) In addition to self-efficacy, which other outcomes have been explored in the studies included in the review?

3. Methods and Procedures

The present review follows the criteria of Boland *et al.* [19], using a ten-stage process to frame the review, wherein searching and screening were performed as per PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) [20]. Moreover, to create a research topic that is both clear and answerable, it is advised that using a model such as PICOS, SPIDER, PICOSS or PICO would be beneficial [21] [22]. The PICO model seemed to be the most suitable since the purpose of this review is to explore the effect of simulation education on undergraduate pre-registration nursing students' self-efficacy. This approach enables researchers to specify the study's purpose as per the following elements: population, intervention, comparison and result [19]. Then, the PICO format can be arranged into a study question.

P—the research **population** comprises undergraduate pre-registration nursing students.

I—the **intervention** under study is simulation training/simulation education.

C—the study **compares** students' self-efficacy scores, pre-intervention and post-intervention, using simulation target skills, the simulation training method and other training approaches.

O—the **outcome** refers to the changes in the self-efficacy of the students' skills in different settings.

3.1. Search Methods

An initial literature search was conducted with assistance from the school librarian. Nonetheless, the PICO model was initially used to identify search terms. Once the initial search terms were identified, a two-stage search procedure was employed: the first stage comprised a search on the MEDLINE database using the library of Queen's University Belfast to identify medical subject headings (MeSH); the second stage comprised a search on the CINAHL Plus, Scopus, PsycINFO and Embase databases, as suggested by the school librarian, to estab-

lish their suitability to supply a broad range of literature in the areas of nursing and other health fields. The keywords identified by the thesaurus and the MeSH terms were searched in all the databases. These keywords were combined using truncation and Boolean logic, such as OR and (Table 1). An illustration of the truncation and Boolean logic and search terms that were used: "simulation education" or "simulation training" and "undergraduate" or "baccalaureate" or "pre-registration" and "nurse*" and "self-efficacy". Lastly, recent studies and reviews were also searched for eligible papers that may have been missed.

3.2. Inclusion/Exclusion Criteria

The exclusion and inclusion criteria were used while reviewing all papers included in this study. The exact criteria are listed below.

Types of studies

Different types of studies were included in the review, ranging from quantitative studies (experimental or quasi-experimental) to qualitative studies and those with a mixed methods approach. Only English and Arabic full-text articles published between 2016 and 2021 were included in the present review. The aim was to locate the most current simulation education research papers. However, case studies, case reports, commentaries, case control studies, pilot studies, opinions, conference proceedings, editorials, and review articles were excluded from this review.

Types of participants

The review included only studies that involved undergraduate pre-registration nursing students of any level or discipline, regardless of variables such as gender, nationality and age. This is because undergraduate baccalaureate nursing students are different from diploma and associate degree nursing students [23]. Hence, studies that involved undergraduate students from associate degree or diploma nursing programmes were not considered. However, research that involved students from other health care fields such as occupational therapists, respiratory therapists, physical therapists and medicine was excluded from the review. Studies that involved newly graduated, post-registration or post-graduate students were also excluded.

Types of intervention

Studies that involved simulation education using role play, mannequins or standardised patients were eligible for inclusion. Hence, the terms "high-fidelity patient simulations", "low-fidelity models" and "medium-fidelity mannequins", role player and live actor were included in the review. Simulation training that was not performed in real time, such as paper-based activities, virtual reality tasks, online simulations or video recordings, were not eligible for inclusion.

Types of outcome measure

Papers pertaining to research that were designed to evaluate the manner in which simulation training impacts self-efficacy amongst undergraduate and pre-registration nursing students were acceptable for inclusion in the review.

Table 1. Boolean operator search.

Baccalaureate OR undergraduate OR "pre-registration" student	
AND	nurse*
AND	"simulation education" OR "simulation training"
AND	self-efficacy

However, papers that failed to emphasise the influence of simulation training on self-efficacy were omitted. The present review included papers that focused on relationships between self-efficacy and other competencies.

3.3. Search Outcomes

The evidence-based items that were encompassed within PRISMA were used in the literature review. Hence, all stages were performed in accordance with these items. The database searches were performed over the period 28 June 2021 to 4 July 2021. In addition, the search process was repeated in January 2022 in order to locate any new publications. The resultant sample comprised 214 potential papers. After the removal of duplicates, 142 papers remained. A subsequent review of the titles and abstracts was conducted, during which 108 papers were found to be irrelevant; 34 relevant papers remained. The next stage was to read the full text of each paper, after which the total number of papers was reduced to 11. The shortlisting process is presented in **Figure 1**. It should be noted that the search was conducted by one reviewer. However, the search strategy and the papers found were reviewed, discussed and agreed with the supervision team.

3.4. Data Extraction and Synthesis

To identify information related to the question of the review, a data extraction form has been developed in accordance with proposed guidelines for systematic reviews [19]. A single independent reviewer extracted the data using a standard form containing the following details: 1) author/year/location; 2) method and research design/sample method/participant/setting; 3) study aims; 4) outcome (measure)/instruments/intervention; 5) results. The data obtained from all quantitative studies were depicted in a narrative form.

By synthesising data, researchers can identify patterns in the data, as well as combine the findings into an overall conclusion that provides readers with information about whether a particular intervention is effective on average [21]. However, statistical analysis of the results could not be achieved due to the differences between the instruments and outcomes used in the included studies. In the absence of complete reporting of the mean and standard deviation for comparable results, a meta-analysis could not be conducted [19]. Thus, the findings have been summarised narratively to describe 1) the differences and similarities of the types of simulation training and the instruments that were used; 2) the methods utilised and their effects on studies and study outcomes; and 3) the characteristics of the interventions and their impact on the study outcomes.

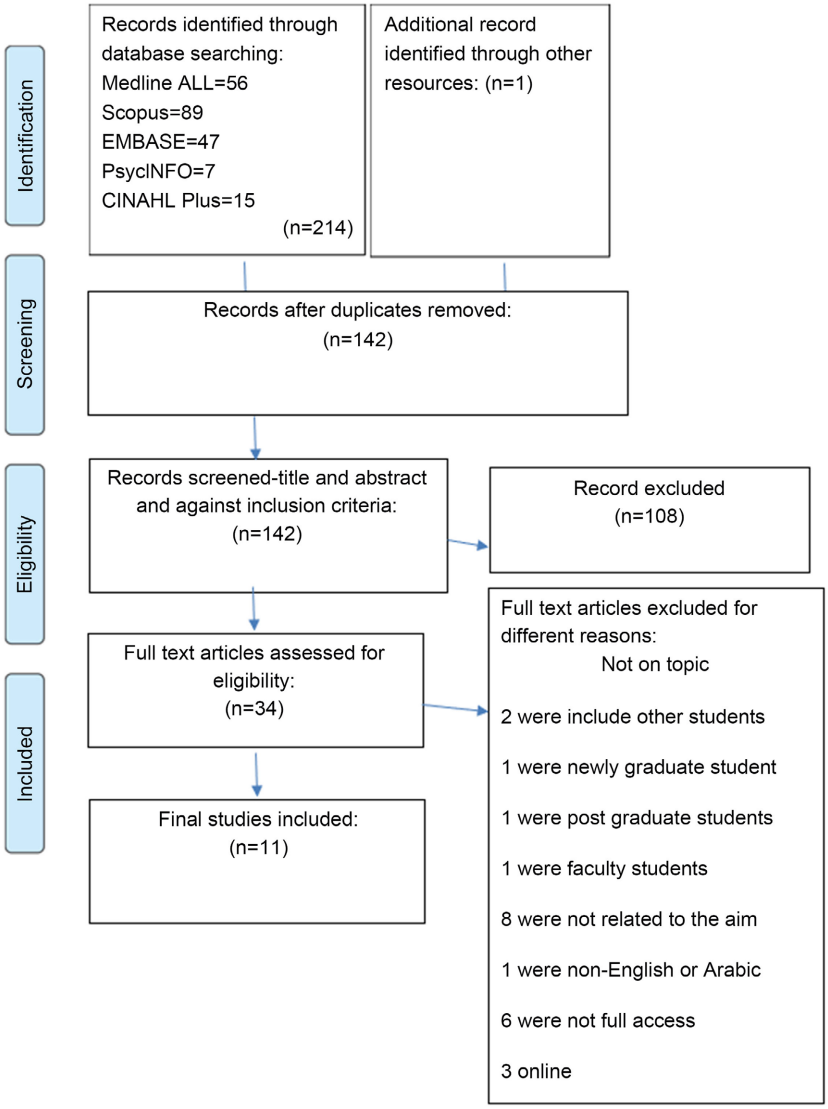

Figure 1. PRISMA flow diagram (Moher *et al.*, 2009).

4. Findings

4.1. Origin of the Studies

The studies included in this systematic review were published between the years 2016 and 2021. Additionally, they were conducted in seven different locations. Appendix 1 presents a summary of relevant information about the 11 included studies: four were conducted in South Korea [24] [25] [26] [27] two were conducted in Turkey [28] [29]; and one each in Saudi Arabia [31], Hong Kong SAR [31], the United States [32], Taiwan region [33] and Denmark [34]. Finally, the number of participants in the included studies ranged from 44 to 255 and all of the studies used quantitative methodology.

4.2. Simulation Types

The included studies used a variety of simulation methods; the most frequently

used were high-fidelity simulations, which were used in five studies [24] [25] [27] [32] [33]. Some of the studies combined high-fidelity simulations with other forms of simulations. For example, the study conducted by Kim [24] used both high-fidelity simulations and role play simulations. Park *et al.* [25] combined high-fidelity models with low-fidelity simulations. Mohamed and Fashafsheh [30] employed a moderate-fidelity medical and critical simulator. In contrast, role play simulations were employed in three studies [24] [31] [34]. Two studies employed standardised patients [28] [31], one of which combined it with role play [31]. Lastly, mannequin type was not identified in two of the studies [26] [29].

4.3. Simulation Scenarios

The scenarios used in simulation training vary significantly in terms of objective and content. The majority of studies focused on the theme of acute care nursing [4] [25] [26] [27] [30] [33] [34]. Cardiac arrest was an implemented scenario in three of the studies [4] [26] [34]. Whereas other scenarios varied, such as in Kim's [24] study, the simulation scenarios focused on simulations pertaining to appropriate defibrillator use and cardiac rhythm confirmation. In the study by Hung *et al.* [33], scenarios included cardiogenic shock arising from acute myocardial infarction, aggravated chronic obstructive pulmonary disease (COPD) combined with respiratory failure, and gunshot trauma. Additionally, in the research conducted by Park *et al.* [25], the simulation scenario was about chest pain and dyspnoea, while Jørgensen *et al.* [34] implemented acute abdominal pain, trauma, acute breathing problems and changes in levels of consciousness scenarios in the intervention group .

A second group of scenarios that was used pertained to paediatric care. Both Arslan *et al.* [29] and Al Gharibi *et al.* [32] conducted research in the area of simulation training: the former involved the administration of paediatric medicine, paediatric assessment, anthropometric measurement and vital signs, whereas the latter's study concerned the acute pneumonia and post-partum haemorrhage in paediatric settings. However, only one study [30] included two scenarios from different branches, which were medical-surgical nursing and critical care nursing, wherein the scenarios concerned ECG, blood transfusion, intravenous injections, oxygen therapy, wound care, stoma care, and Ryle tube insertion and removal.

The scenario topic in two of the papers did not reveal what branch of nursing care would be involved. However, one of them was about first-year students. The scenarios were related to body mechanics, effective patient transfer and successful patient communication [28]. The other study's topic evaluated an adverse event in two scenarios: inaccurate urinary catheter removal and specimen loss [31].

4.4. Period and Duration

The simulation durations and number of training sessions varied between stud-

ies. Some studies conducted simulations in several sessions, while others conducted the simulation training on a weekly basis for a specific period of time. However, most of the studies used sessions to perform simulation training, ranging from one to 13 sessions [24] [31] [32] [33] [34]. In the United States, Al Gharibi *et al.* [32] conducted a repeated measurement study that included a maximum of 13 simulation sessions, with each session lasting for nearly three hours. However, other studies involved fewer than three sessions, such as one conducted in Taiwan region by Hung *et al.* [33] that involved three sessions, each of which lasted for 75 minutes in different weeks. Two studies used just two simulation training sessions: Kim's [24] study in South Korea, which used two three-hour sessions in ten days; and a study conducted by Jørgensen *et al.* [34] in Denmark, which used a two-day simulation training session. Lastly, Yeung [31] conducted a study in Hong Kong SAR comprising one session that lasted for just two hours.

The other studies conducted simulation training on a weekly basis for specified durations of time [26] [27] [28] [29] [30]. For example, in a study conducted in South Korea, simulation training was implemented once a week for two hours each for a total of 16 weeks, amounting to a total of 32 hours – the longest period of training among the studies reviewed [27]. In a study conducted in Turkey, simulation training was conducted for four weeks, which is less, but had long training hours at 12 hours per week, giving a total of 48 hours of simulation-based training [29]. The rest of the studies were shorter periods of weeks and hours of simulation training. For example, in a study conducted in Saudi Arabia, the researcher conducted simulation training for 16 hours a week for three weeks during the course [30]. In a study conducted in South Korea, the session was conducted on a daily basis for two weeks of two-hour simulation-based resuscitation training [26].

However, only two studies reported the time simulation training without clarifying the period or weeks of the training: a 20-hour study conducted in Turkey [28]; and one in South Korea involving 30 hours of simulation-based training [25].

4.5. Methodological Quality Assessment

A single author evaluated the quality of the reviewed studies independently by using the SRR [35]. Nevertheless, it has been suggested that assessing the quality of the evaluation should be conducted by more than one person in order to verify the findings [21]. Therefore, this issue may be recognised as a shortcoming of this study, and it is discussed within the limitations section of the paper. However, the quality scores of experimental and quasi-experimental studies in this review were good to very good and ranged from 64% to 88% out of a possible score of 100%. All 11 studies reviewed had several methodological issues (Appendix 2). In quasi-experimental studies, the most common flaws were the absence of a control group, a small sample size, a lack of control over external factors, and a short follow-up period. In the case of experimental studies, they

frequently suffered from inadequate blinding, particularly from outcome evaluators, which was the most common shortcoming. Notably, experimental studies scored lower than some pre-test–post-test quasi-experimental studies (Appendix 2). Further, since this review was focused on simulation-based training, a specific appraisal tool was necessary to assess the simulation studies. Therefore, there are many papers that have issues relating to aspects of simulations, such as development of simulation scenarios, which have not been discussed correctly. Another limitation relates to debriefing, which has not been adequately clarified in many papers.

4.6. Description of the Main Results

This systematic review has centred on self-efficacy among nursing students. Thus, all the included studies had explored this area in relation to simulation training. The majority of studies found that simulation training has a positive effect; only one study concluded the opposite. In addition to these findings related to self-efficacy, the included studies presented interesting findings related to other variables. Nevertheless, the result of other outcome variables in this review emphasised that simulation not only increases students' self - efficacy, but also that there are some conclusions indicating that it can increase knowledge, critical thinking levels, clinical nursing competence, communication, and learning motivation. Only Karabacak *et al.* [28] suggested that simulation could reduce student proficiency. Nevertheless, three themes emerged from this review, namely: 1) simulation training influences students' attitude; 2) simulation training impacts students' skills and knowledge; 3) nursing students' perceptions of simulation training and satisfaction.

4.6.1. Impact of Simulation Training on Students' Attitude

The first theme that emerged in this literature review was the impact of simulation education on nursing students' attitude after being exposed to simulation training. One of the characteristics of simulation is that it is commonly used to measure attitudes such as self-efficacy [36]. As this review primarily aims to explore the impact of simulation on undergraduate pre-registration nursing students' self-efficacy, all the papers included examined the self-efficacy outcome. In addition to self-efficacy, anxiety levels and learning motivation were investigated once in the included studies.

Self-efficacy outcomes

The majority of simulation research included in this systematic review has suggested that simulation training can enhance self-efficacy amongst undergraduate pre-registration nursing students [24] [25] [26] [27] [29]-[34]. However, Karabacak *et al.* [28] indicated that simulation training can generate negative impacts on self-efficacy.

Five studies presented their findings in relation to two groups, post-testing and pre-testing, or post-testing alone [24] [27] [29] [31] [34]. Arslan *et al.* [29] explored the impact of simulation-based training on the self-efficacy of third-year

undergraduate nursing students in Turkey compared to that of students who underwent conventional training. They concluded that students who received simulation training (the experimental group) exhibited greater self-efficacy than students who received traditional training (the control group) in relation to all implementation areas. Similarly, in Denmark, Jørgensen *et al.* [34] compared conventional classroom lessons with classroom lessons that included simulations. Thus, both the control and intervention groups attended a traditional lesson, but the intervention group received an additional two days of simulation training. The findings from this study showed that the students' self-efficacy in the intervention group was much higher as compared to the control group. Lee *et al.* (2016) evaluated the manner in which a clinical reasoning module conducted in accordance with high-fidelity simulation precepts impacted the self-efficacy of 49 senior nursing students in South Korea. Two groups were used, wherein the control groups experienced conventional teaching methods and the experimental group experienced simulation education related to the clinical reasoning course component. The findings showed that the experimental group exhibited increased self-efficacy, although the difference between this group and the control group was not statistically significant.

The research conducted by Yeung [31] was slightly different wherein it compared different forms of simulation training (peer role play and simulated patients) in order to ascertain their impact on the self-efficacy of 44 fourth-year nursing students in Hong Kong SAR in the context of adverse event disclosures. The comparison between the baseline and the post-intervention state was greater in the groups that experienced the simulated patient method. However, both groups demonstrated improvements in relation to baseline levels. In contrast, the study performed by Kim [24] compared the extent to which simulation influenced self-efficacy amongst South Korean nursing students when delivered using two diverse teaching approaches (role playing and lectures). The finding indicated that the use of simulation after role play was more effective than the use of simulation after lectures in all areas, with the exception of prudence and self-efficacy.

The remaining six studies recorded self-efficacy levels through pre-testing and post-testing or post-testing only with no comparison group [25] [26] [27] [30] [32] [33]. Roh *et al.* [26] assessed the self-efficacy of 255 nursing students in South Korea to determine the efficiency of integrated simulation-based resuscitation skills training paired with a clinical practicum. In comparison to the baseline, nursing students' self-efficacy increased significantly after completing simulation-based resuscitation training. Similar results were found in a study conducted in South Korea by Park *et al.* (2017) to explore the impact of simulation training in context to an integrated nursing practicum as per the Jeffries Simulation Framework on students' self-efficacy. Thus, the research concluded that compared to the pre-test, the self-efficacy of the 69 senior Korean nursing students participating had significantly increased following the simulation-based practicum. In a similar vein, Mohamed and Fashafsheh [30] used moderate-fidelity

simulations to investigate the impact of simulation-based training on 100 third- and fourth-year undergraduate nursing students in Saudi Arabia. The study revealed that the mean scores on the self-efficacy scale were elevated following the simulation in comparison to the baseline. A study conducted by Karabacak *et al.* [28] investigated the manner in which simulation-based learning affected self-efficacy among first-year nursing students in Turkey by comparing pre- and post-simulation scores to target skills. Uniquely, the study found that the mean self-efficacy score decreased after the simulation training compared to the pre-simulation value [28].

Notably, two studies had repeated measurements, indicating consistent outcomes [32] [33]. Specifically, Al Gharibi *et al.* [32] examined the impact of repeated simulation training on junior and senior nursing students in the United States by conducting 13 simulation sessions. Self-efficacy was assessed three times throughout the 13 simulation training sessions: a pre-test, a mid-point test and a post-test. The study indicated that self-efficacy increased when the simulation scenario was repeated, in contrast to the self-efficacy levels reported prior to the simulation training [32]. Similarly, Hung *et al.* [33] conducted three repeated simulation sessions with three unique scenarios to determine the self-efficacy levels of Taiwanese nursing students when exposed to repeated simulation. During the three sessions, self-efficacy was assessed four times, at baseline and after each session. The results showed that there were statistically significant improvements in self-efficacy scores compared to the baseline data, although the results after the first and second scenarios did not reach statistical significance [33].

Anxiety levels and learning motivation outcomes

An examination of anxiety levels and learning motivation outcomes was conducted once. Using a two-group, quasi-experimental design, Arslan *et al.* [29] evaluated anxiety traits and state anxiety levels in the two groups. They did not find any differences between the groups in terms of state anxiety mean scores. In the group that received simulation-based training, mean trait anxiety scores were decreased significantly. In terms of learning motivation, based on research conducted by Park *et al.* [25], the study compared the effects of simulation-based practicum learning on nursing students' learning motivation before and after training and concluded that students' performance had been significantly enhanced.

4.6.2. Impact of Simulation Training on Students' Skills and Knowledge

The second theme that emerged from this literature review was the effect of simulation education on the skills and knowledge of nursing students who were exposed to it. However, in much of the simulation literature, the terms "competence", "skill", "performance" and "behaviour" were commonly used and expressed in relation to observable skills of learners [36]. In this review, six papers address nursing clinical competence in general, while other papers focus on a single nursing skill, such as critical thinking, knowledge acquisition, psychomo-

tor skills, problem-solving skills and communication skills [25] [26] [27] [29] [30] [33].

Competence outcomes

Nursing students' competence was investigated in six studies. Four papers examined it pre and post simulation training, and three of them reported a positive impact on nursing students' competence [24] [25] [27]. Only one study discovered that simulation education reduced student competence [28].

To illustrate, Mohamed and Fashafsheh [30] examined students' clinical competence using a tool that examined various skills such as students' performance ability, psychosocial nursing ability, abilities to perform directed intervention and others, concluding that the mean clinical competence scores of nursing students in Saudi Arabia increased compared to pre-test scores. Similarly, Lee *et al.* [27] used a nursing core competencies measurement tool that examined various nursing skills such as critical thinking skill, human understanding, communication skills and others, asserting that students' basic competency was enhanced through their engagement in simulations. Hung *et al.* [33] used the SBLES to investigate different skills such as communication skills, professional knowledge, nursing process and others; they observed that the competence level of the nursing students was enhanced after participating in several simulation training sessions. Only the study by Karabacak *et al.* [28] showed a reduction in the competence level among nursing students after simulation lessons.

In the other two papers, the authors evaluated only whether self-efficacy was associated with other outcome variables [25] [31]. For example, the study by Yeung [31] compared the SP and PRP methods for AED training in the undergraduate nursing curriculum based on performance only in the post-test phase. However, he concluded that there was no significant difference between groups for any of the constructs. Similarly, in the study by Park *et al.* [25], who used a one-group, pre- and post-test design, performance skill was only examined following simulation training in order to compare its association with other outcome variables.

Critical thinking outcomes

In two papers, critical thinking skills were explored. Both reported that the simulation training increased students' critical thinking [24] [25]. In a study conducted by Park *et al.* [25], students' critical thinking abilities were evaluated before and after simulation training, concluding that the students' critical thinking skills were improved. The same conclusion was reached by Kim [24], who examined the nursing students' critical thinking following pre- and post-simulation training following a lecture and role play instruction.

Knowledge outcomes

Knowledge was investigated in two papers [26] [34]. Jørgensen *et al.* [34] compared students' basic knowledge following simulation training and found that there was no significant difference between the experimental and control groups. In contrast, Roh *et al.* [26] examined students' knowledge of CPR before

and after simulation-based resuscitation and concluded that the score of students' CPR knowledge had increased significantly in comparison to the baseline.

Various outcomes

Other skills were examined once each, including problem-solving [27], communication skills [30] and CPR skills [26]. All three studies reported the positive influence of simulation training on undergraduate pre-registration students. To clarify, a study conducted by Roh *et al.* [26] explored CPR psychomotor skills among senior nursing students and the results concluded that simulation training benefited them. Specifically, after attending the simulation-based resuscitation course and the emergency department practicum, CPR competency levels were significantly enhanced. Mohamed and Fashafsheh [30] explored communication skills among Saudi nursing students using a specific communication skills scale; the results concluded that the skills were elevated following simulation instruction. In addition, in their exploration of students' problem-solving competencies, Lee *et al.* [27] noted that those who had experienced simulation training were more adept in this area than those in the control group. However, the difference between the two groups was not statistically significant.

4.6.3. Nursing Student Perceptions of Simulation Training and Satisfaction

A third theme that emerged from this literature review was the perspective of student learning and satisfaction regarding simulation education. As part of this review, two studies covered the views and satisfaction of participants with regard to simulation training, and one study covered the perspective of students regarding the learning process with simulation training. All three were positive toward simulation training [25] [33] [34]. To illustrate, a study by Hung *et al.* [33] examined changes in nursing students' perceptions of learning satisfaction following repeated exposure to simulations, concluding that the perspective of nursing students' perceptions of learning satisfaction had improved significantly. Similarly, Jørgensen *et al.* [34] investigated the perceptions of nursing students toward the simulation training process three times. The group perceptions of the learning process did not differ between the groups at the baseline. Nevertheless, post-intervention analysis of the learning process revealed that the intervention group perceived learning more positively than the control group (See **Table 2**).

Table 2. Three major themes identified in the literature.

Impact of simulation training on students' attitude	Impact of simulation training on students' skills and knowledge	Nursing student perceptions of simulation training and satisfaction
1. Self-efficacy 2. Learning motivation 3. Anxiety level	1. Nursing students' clinical performance 2. Critical thinking skills 3. Knowledge aquation 4. Communication skills 5. Problem-solving skills 6. Psychomotor skills	1. The perspective of student learning and satisfaction in relation to simulation education

5. Discussion

Although simulation had a positive effect on students' self-efficacy in many studies, it was not statistically significant in some studies, but was statistically significant in others. As a result, the disparity between the studies' findings requires caution in evaluating them. Additionally, the methodology has some inherent limitations, such as a lack of statistical power, an absence of randomisation, and inadequate variance estimates. Thus, although the findings of this review suggest that educational simulation is an effective teaching tool, caution should be exercised when interpreting the results.

Nevertheless, the evidence from the systematic review by La Cerra *et al.* [37] is in contrast to the result of this systematic review. It did not confirm the benefits of simulation education, specifically, a high-fidelity simulator, to facilitate improving nursing students' self-efficacy. On the other hand, a number of previous simulation studies have concurred with this review in regard to the efficacy of simulation education on undergraduate pre-registration nursing students' self-efficacy. As an example, the current results are consistent with previous systematic reviews that have examined the simulation topic and highlighted the importance of simulation training for enhancing nursing students' self-efficacy [16]. A notable finding is that two reviews came to the same conclusion regarding the effectiveness of simulation training, despite reviewing different forms of simulation training. To illustrate, Hanshaw and Dickerson [38] conducted a systematic review that evaluated the outcomes of high-fidelity simulation training in undergraduate pre-registration baccalaureate nursing students, concluding that using a form of high-fidelity simulation could increase students' self-efficacy. Similarly, Oh *et al.* [39] conducted a meta-analysis to evaluate the impact of simulation-based learning using a standardised patient type, concluding that the outcomes of their study suggest that simulation-based learning using standardised patients could positively influence self-efficacy. The conclusion is that even though the types of simulation training differed, most of the studies agreed that simulation training positively impacts students' self-efficacy.

Furthermore, a number of literature reviews of simulation education conducted on specific branches of nursing education all reported that simulation education was an effectiveness in increasing pre-registration nursing students. As an example, Kunst *et al.* [40] conducted an integrative review of the impact of simulation education on undergraduate mental health nursing students. Based on their synthesis results, simulation was found to increase learners' self-efficacy in terms of communication and knowledge in mental health care. Similar to Akalin and Sahin [41], an integrative review was conducted to examine the effects of obstetric simulation in an undergraduate nursing programme. The result of the review concluded that the use of obstetric simulation in an undergraduate nursing programme has a positive effect on the level of self-efficacy. In other words, many previous literature reviews of simulation training have confirmed its effectiveness in increasing undergraduate pre-registration nursing students'

self-efficacy regardless of whether the simulation training is high-fidelity or standardised, or whether the simulation is for mental health or obstetric nursing or any branch of nursing students.

In addition, simulation training has been shown to successfully alleviate anxiety in nursing students following simulation session, as demonstrated by the study reviewed [29]. Nevertheless, although anxiety level was examined once in the present review, the results were fairly consistent with those of previous studies emphasising the effectiveness of simulation education in reducing anxiety and fear in nursing students when they are performing their nursing duties and handling patients [41] [42]. Alleviating anxiety is essential as nursing students may not be able to provide their patients with good care if they are highly anxious [42]. This occurs because anxiety may inhibit students from reflecting correctly on their knowledge of patient care in the clinical setting [43]. In addition, simulation training appears to successfully increase learning motivation among nursing students after simulation, as supported by the descriptive study that was reviewed [25]. Learning motivation may play an important role in education process, as student motivation positively influenced the knowledge and the acquisition of clinical skills [39]. However, a number of previous reviews of the literature regarding the impact of simulation education on nursing student learning motivation have concluded that simulation training motivates pre-registration nursing students [38] [39]. Hence, it demonstrates the effectiveness of simulation education as an educational strategy.

Additionally, as demonstrated by the included descriptive studies in this review, simulation appears to be a significant factor in increasing nursing students' clinical competency, critical thinking and communication skills; however, the validity of this finding should be interpreted with caution due to the slight variation in the scales used to measure clinical competence. Nursing competence is a multidimensional concept that includes knowledge, skills, values, attitudes, communication, cooperation, critical thinking and innovation. However, some of the included articles in this review considered critical thinking and communication skills to be a single competency, while others looked at them as components of nursing clinical competence. Therefore, it is challenging to draw conclusions from comparing these papers to each other or to previous ones. Yuan *et al.* [3] reviewed 14 papers that examined the effectiveness of high-fidelity simulation in enhancing nursing students' competencies and concluded that sufficient evidence was not available to support the claim. Thus, Yuan *et al.* [44] recommended the development of standardised objective evaluation tools for measuring competency.

However, in terms of critical thinking, the present findings are in line with the findings of previous literature reviews, which stated that simulations can enhance critical thinking skills among nursing students during patient interactions and nursing duties [38] [41]. Nursing care is dependent on nurses making accurate decisions and taking appropriate measures to ensure that patients' lives are

protected [45]. Therefore, it is imperative that nursing students develop the necessary skills to become responsible, creative and critical thinkers, enabling them to make correct decisions and deal with the problems encountered during clinical training [46]. Simulation education could enable nursing students to understand real-life situations in a realistic manner and thereby enhance their ability to think critically.

Nevertheless, there are also literature reviews that do not fully confirm the efficacy of simulation training on nursing students' critical thinking. In a review of 12 studies about critical thinking, only half showed an improvement in critical thinking skills compared with a control group [47]. Adib-Hajbaghery and Sharifi [48] conducted a systematic review of 16 publications and found conflicting results, with half indicating that simulation training improved students' critical thinking and the other half indicating it did not. Thus, it is necessary to further explore the impact of simulation training on pre-registration nursing students' critical thinking in the context of simulation education.

Furthermore, in terms of communication skills, simulation can provide an effective methodology for teaching communication abilities, emphasising the essential role of communication skills and allowing students to build a repertoire of effective strategies [49]. Communication is more than just listening; it involves responding to nonverbal signals as well. Using a simulation patient is one strategy that students may use to assist them in meeting the objectives of therapeutic communication [50]. By practicing these skills in a safe environment and receiving real-time feedback, students can improve their learning. Carson and Harder [51] found that students believed that they could adapt the communication abilities they had gained through simulation to real-world circumstances. In this review, only Mohamed and Fashafsheh [30] explored communication skills among Saudi nursing students using a specific communication skills scale. The results showed that the skills were elevated following simulation instruction. However, Mohamed and Fashafsheh [30] examined nursing clinical competence using a tool that did not include communication skills and used a specific tool to assess it, while Lee *et al.* [27] and Hung *et al.* [33] examined communication skills among nursing students using a nursing competence tool that included communication skills. This confirms the dissimilarity in the scales used. However, Lee *et al.* [27] and Hung *et al.* [33] examined nursing clinical competence using a competence tool that considered communication skills, concluding that communication skills were positively influenced by exposure to simulation training.

In addition, simulation education appears to be effective in improving nursing students' knowledge after simulation, as revealed by studies included in this review [26] [34]. Many previous literature reviews have supported the present findings, emphasising the important role that simulation training can play in enhancing nursing students' knowledge [38] [39] [52]. The success of nursing practice depends on the application of nursing knowledge [53]. In a simulation

environment, normal to critical clinical situations are re-created to avoid the risk of harming a real patient. As a result, participants can apply their knowledge in a safe and controlled environment [54]. Nevertheless, other literature reviews were inconclusive regarding the effectiveness of simulation training on students' knowledge acquisition [3] [55]. Therefore, to confirm whether simulation training is effective in helping undergraduate nursing students acquire knowledge, further research is needed.

Only one paper reported the success of simulation education in increasing problem-solving skills among nursing students after simulation training [27]. Seo and Eom [56] found that a simulation nursing education programme based on the Outcome-Present State-Test model was effective in improving problem-solving skills. Solving problems is an essential nursing skill because it allows nurses to make informed decisions as part of an effective knowledge-based, problem-solving strategy [56]. However, only a few studies have examined how simulation education may affect nursing students' ability to solve problems. Thus, more studies are required in this regard.

Finally, the assessment of the current study's findings indicates that nursing students are satisfied with simulation training [25] [33], and that simulation education is perceived more positively than any other learning methodology [34]. A prior literature review conducted on the subject of simulation training found that nursing students were highly satisfied with the use of simulations [52]. Students' satisfaction with their nursing programmes was a critical component to promoting learning, as it was associated with increased student engagement and motivation, which can lead to increased performance and learning outcomes [43]. According to Karabacak *et al.* [28], students who were satisfied with simulation learning were likelier to perceive themselves as qualified to conduct needed nursing tasks. However, Oh *et al.* [39] found no significant improvement in the perceived level of learning satisfaction of students using simulation-based learning, probably because of the high level of heterogeneity in the group they studied. Additionally, other studies have failed to find conclusive evidence of the effectiveness of simulation education in achieving student satisfaction [37] [55]. Therefore, there is still a need for additional research using larger samples and examining what nursing students are most and least satisfied with regarding these programmes.

6. Conclusion

A systematic search was performed throughout all relevant electronic databases, and 11 articles relating to simulation education for nursing students were identified. Based on the results of this systematic search, the following three questions have been addressed: 1) Does simulation education influence the self-efficacy of pre-registration nursing students? 2) How effective is simulation education in comparison to other teaching methodologies? 3) Aside from self-efficacy, what outcomes have other studies included in the review investigated? In this context,

simulation education outcomes were identified and described, as well as gaps in the literature. As an illustration, despite the methodological shortcomings of some of the studies, the literature review provided an updated assessment of the effectiveness of simulation education for improving nurses' self-efficacy. In addition, this synthesis has identified positive influences of simulation training on all other learning outcomes that have been investigated, suggesting that high-fidelity simulator training and standardised patient simulations may be beneficial in improving self-efficacy and nurses' knowledge and skills, learning motivation, communication skills and problem-solving abilities regarding the assessment and management of patients. As part of this review of the literature, it was demonstrated that despite there only being three studies that compared simulation training to other methods of teaching, all results indicated that simulation education is significantly superior to traditional training. It is therefore necessary to conduct more studies in order to demonstrate the effectiveness of simulation training compared to traditional education. In addition, based on the limitations of studies reviewed in this study, more research is necessary to explore this aspect of nursing education. This review identified a number of studies that had weak designs, small sample sizes and limited analyses, lacking critical data and details on research methodologies. More high-quality and robust pre-test and post-test multisite experimental studies with reliable and valid instruments as well as larger sample sizes should be conducted to measure the effect of simulation training on students' self-efficacy and other outcomes. It is necessary to develop objective evaluation tools that can measure self-efficacy and nursing clinical competence in a standardised way. This review suggests that integrating simulation into the curriculum as an educational strategy could enhance the quality of nursing education through its use as an educational strategy.

Conflicts of Interest

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

References

[1] Awad, M.S., Abdullah, M.K., Ibrahim, R.H. and Abdulla, R.K. (2019) Nursing Students' Attitudes toward Simulation Technology in Nursing Education. *International Journal of Emerging Technologies in Learning*, **14**, 31. https://doi.org/10.3991/ijet.v14i14.10571

[2] Shin, S., Park, J.H. and Kim, J.H. (2015) Effectiveness of Patient Simulation in Nursing Education: Meta-Analysis. *Nurse Education Today*, **35**, 176-182. https://doi.org/10.1016/j.nedt.2014.09.009

[3] Yuan, H.B., Williams, B.A., Fang, J.B. and Ye, Q.H. (2012) A Systematic Review of Selected Evidence on Improving Knowledge and Skills through High-Fidelity Simulation. *Nurse Education Today*, **32**, 294-298. https://doi.org/10.1016/j.nedt.2011.07.010

[4] Kim, J., Park, J.H. and Shin, S. (2016) Effectiveness of Simulation-Based Nursing Education Depending on Fidelity: A Meta-Analysis. *BMC Medical Education*, **16**, Ar-

ticle No. 152. https://doi.org/10.1186/s12909-016-0672-7

[5] Ricketts, B., Merriman, C. and Stayt, L. (2012) Simulated Practice Learning in a Pre-registration Programme. *British Journal of Nursing*, **21**, 435-440. https://doi.org/10.12968/bjon.2012.21.7.435

[6] Glasper, A. (2021) Simulation and Student Learning: Will NMC Policy Lead to Lasting Change? *British Journal of Nursing* **30**, 498-499. https://doi.org/10.12968/bjon.2021.30.8.498

[7] Hayden, J.K., Smiley, R.A., Alexander, M., Kardong-Edgren, S. and Jeffries, P.R. (2014) The NCSBN National Simulation Study: A Longitudinal, Randomized, Controlled Study Replacing Clinical Hours with Simulation in Prelicensure Nursing Education. *Journal of Nursing Regulation*, **5**, S3-S40. https://doi.org/10.1016/s2155-8256(15)30062-4

[8] Koukourikos, K., Tsaloglidou, A., Kourkouta, L., Papathanasiou, I., Iliadis, C., Fratzana, A. and Panagiotou, A. (2021) Simulation in Clinical Nursing Education. *Acta Informatica Medica*, **29**, 15-20. https://doi.org/10.5455/aim.2021.29.15-20

[9] Lavoie, P. and Clarke, S.P. (2017) Simulation in Nursing Education. *Nursing*, **47**, 18-20. https://doi.org/10.1097/01.nurse.0000520520.99696.9a

[10] Stalheim, O.R. and Nordkvelle, Y. (2018) I Saved the Patient: Simulation and Self-Efficacy in Health Education. In: Hodges, C., Ed., *Self-Efficacy in Instructional Technology Contexts*, Springer, Berlin, 75-88.

[11] Kiernan, L.C. (2018) Evaluating Competence and Confidence Using Simulation Technology. *Nursing*, **48**, 45-52. https://doi.org/10.1097/01.nurse.0000545022.36908.f3

[12] Kapucu, S. (2017) The Effects of Using Simulation in Nursing Education: A Thorax Trauma, Case Scenario. *International Journal of Caring Sciences*, **10**, 1069-1073. https://doi.org/10.12691/ajnr-7-5-18

[13] Van Horn, E. and Christman, J. (2017) Assessment of Nursing Student Confidence Using the Clinical Skills Self-Efficacy Scale. *Nursing Education Perspectives*, **38**, 344-346. https://doi.org/10.1097/01.nep.0000000000000169

[14] Bandura, A. (1977) Self-Efficacy: Toward a Unifying Theory of Behavioral Change. *Psychological Review*, **84**, 191-215. https://doi.org/10.1037/0033-295x.84.2.191

[15] Lugo, R.G., Hjelmeland, I., Hansen, M.T., Haug, E., Sütterlin, S. and Grønlien, H.K. (2021) Impact of Initial Emotional States and Self-Efficacy Changes on Nursing Students' Practical Skills Performance in Simulation-Based Education. *Nursing Reports*, **11**, 267-278. https://doi.org/10.3390/nursrep11020026

[16] Franklin, A.E. and Lee, C.S. (2014) Effectiveness of Simulation for Improvement in Self-Efficacy among Novice Nurses: A Meta-Analysis. *Journal of Nursing Education*, **53**, 607-614. https://doi.org/10.3928/01484834-20141023-03

[17] Artino, A.R. (2012) Academic Self-Efficacy: from Educational Theory to Instructional Practice. *Perspectives on Medical Education*, **1**, 76-85. https://doi.org/10.1007/s40037-012-0012-5

[18] Klassen, R.M. and Klassen, J.R.L. (2018) Self-Efficacy Beliefs of Medical Students: A Critical Review. *Perspectives on Medical Education*, **7**, 76-82. https://doi.org/10.1007/s40037-018-0411-3

[19] Boland, A., Cherry, M.G. and Dickson, R. (2017) Doing a Systematic Review: A Student's Guide. 2nd Edition, Sage, Los Angeles.

[20] Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G. and The PRISMA Group (2009) Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA

Statement. *PLOS Medicine*, **6**, p.e1000097.
https://doi.org/10.1371/journal.pmed.1000097

[21] Booth, A., Suttion, A. and Papaioannou, D. (2016) Systematic Approaches to a Successful Literature Review. 2nd Edition, Sage, London.

[22] Methley, A.M., Campbell, S., Chew-Graham, C., McNally, R. and Cheraghi-Sohi, S. (2014) PICO, PICOS and SPIDER: A Comparison Study of Specificity and Sensitivity in Three Search Tools for Qualitative Systematic Reviews. *BMC Health Services Research*, **14**, Article No. 579. https://doi.org/10.1186/s12913-014-0579-0

[23] Mok, H.T., So, C.F. and Chung, J.W.Y. (2016) Effectiveness of High-Fidelity Patient Simulation in Teaching Clinical Reasoning Skills. *Clinical Simulation in Nursing*, **12**, 453-467. https://doi.org/10.1016/j.ecns.2016.06.003

[24] Kim, E. (2018) Effect of Simulation-Based Emergency Cardiac Arrest Education on Nursing Students' Self-Efficacy and Critical Thinking Skills: Roleplay versus Lecture. *Nurse Education Today*, **61**, 258-263.
https://doi.org/10.1016/j.nedt.2017.12.003

[25] Park, H.R., Park, J.W., Kim, C.J. and Song, J.E. (2017) Development and Validation of Simulation Teaching Strategies in an Integrated Nursing Practicum. *Collegian*, **24**, 479-486. https://doi.org/10.1016/j.colegn.2016.10.007

[26] Roh, Y.S., Lim, E.J. and Barry Issenberg, S. (2016) Effects of an Integrated Simulation-Based Resuscitation Skills Training with Clinical Practicum on Mastery Learning and Self-Efficacy in Nursing Students. *Collegian*, **23**, 53-59.
https://doi.org/10.1016/j.colegn.2014.10.002

[27] Lee, J., Lee, Y., Lee, S. and Bae, J. (2016) Effects of High-Fidelity Patient Simulation Led Clinical Reasoning Course: Focused on Nursing Core Competencies, Problem Solving, and Academic Self-Efficacy. *Japan Journal of Nursing Science*, **13**, 20-28.
https://doi.org/10.1111/jjns.12080

[28] Karabacak, U., Unver, V., Ugur, E., Kocatepe, V., Ocaktan, N., Ates, E. and Uslu, Y. (2019) Examining the Effect of Simulation Based Learning on Self-Efficacy and Performance of First-Year Nursing Students. *Nurse Education in Practice*, **36**, 139-143.
https://doi.org/10.1016/j.nepr.2019.03.012

[29] Arslan, F.T., Türkmen, A.S., Çelen, R., Özkan, S., Altıparmak, D. and Şahin, A. (2018) Comparing Traditional and Simulation-Based Experiences in Pediatrics with Undergraduate Nursing Students in Turkey. *Clinical Simulation in Nursing*, **16**, 62-69.
https://doi.org/10.1016/j.ecns.2017.10.012

[30] Mohamed, S.A. and Fashafsheh, I.H. (2019) The Effect of Simulation-Based Training on Nursing Students' Communication Skill, Self-Efficacy and Clinical Competence for Nursing Practice. *Open Journal of Nursing*, **9**, 855-869.
https://doi.org/10.4236/ojn.2019.98064

[31] Yeung, J.W.Y. (2019) Adverse Event Disclosure Training for Nursing Students: Peer Role-Play and Simulated Patients. *International Journal of Nursing Education Scholarship*, **16**, Article ID: 20190094. https://doi.org/10.1515/ijnes-2019-0094

[32] Al Gharibi, K.A., Schmidt, N. and Arulappan, J. (2021) Effect of Repeated Simulation Experience on Perceived Self-Efficacy among Undergraduate Nursing Students. *Nurse Education Today*, **106**, Article ID: 105057.
https://doi.org/10.1016/j.nedt.2021.105057

[33] Hung, C.C., Kao, H.F.S., Liu, H.C., Liang, H.F., Chu, T.P. and Lee, B.O. (2021) Effects of Simulation-Based Learning on Nursing Students' Perceived Competence, Self-Efficacy, and Learning satisfaction: A Repeat Measurement Method. *Nurse Education Today*, **97**, Article ID: 104725. https://doi.org/10.1016/j.nedt.2020.104725

[34] Jørgensen, B.E., Larsen, M. and Gram, B. (2018) Simulation as an Educational Tool in Acute Nursing Care: A Controlled Intervention Study. *Nurse Education in Practice*, **32**, 28-33. https://doi.org/10.1016/j.nepr.2018.07.001

[35] Fey, M.K., Gloe, D. and Mariani, B. (2015) Assessing the Quality of Simulation-Based Research Articles: A Rating Rubric. *Clinical Simulation in Nursing*, **11**, 496-504. https://doi.org/10.1016/j.ecns.2015.10.005

[36] Warren, J.N., Luctkar-Flude, M., Godfrey, C. and Lukewich, J. (2016) A Systematic Review of the Effectiveness of Simulation-Based Education on Satisfaction and Learning Outcomes in Nurse Practitioner Programs. *Nurse Education Today*, **46**, 99-108. https://doi.org/10.1016/j.nedt.2016.08.023

[37] La Cerra, C., Dante, A., Caponnetto, V., Franconi, I., Gaxhja, E., Petrucci, C., Alfes, C.M. and Lancia, L. (2019) Effects of High-Fidelity Simulation Based on Life-Threatening Clinical Condition Scenarios on Learning Outcomes of Undergraduate and Postgraduate Nursing Students: A Systematic Review and Meta-Analysis. *BMJ Open*, **9**, e025306. https://doi.org/10.1136/bmjopen-2018-025306

[38] Hanshaw, S.L. and Dickerson, S.S. (2020) High Fidelity Simulation Evaluation Studies in Nursing Education: A Review of the Literature. *Nurse Education in Practice*, **46**, Article ID: 102818. https://doi.org/10.1016/j.nepr.2020.102818

[39] Oh, P.J., Jeon, K.D. and Koh, M.S. (2015) The Effects of Simulation-Based Learning Using Standardized Patients in Nursing Students: A Meta-Analysis. *Nurse Education Today*, **35**, e6-e15. https://doi.org/10.1016/j.nedt.2015.01.019

[40] Kunst, E.L., Mitchell, M. and Johnston, A.N.B. (2016) Manikin Simulation in Mental Health Nursing Education: An Integrative Review. *Clinical Simulation in Nursing*, **12**, 484-495. https://doi.org/10.1016/j.ecns.2016.07.010

[41] Akalin, A. and Sahin, S. (2020) Obstetric Simulation in Undergraduate Nursing Education: An Integrative Review. *Nursing Forum*, **55**, 369-379. https://doi.org/10.1111/nuf.12437

[42] Labrague, L.J., McEnroe-Petitte, D.M., Bowling, A.M., Nwafor, C.E. and Tsaras, K. (2019) High-Fidelity Simulation and Nursing Students' Anxiety and Self-Confidence: A Systematic Review. *Nursing Forum*, **54**, 358-368. https://doi.org/10.1111/nuf.12337

[43] Cabañero-Martínez, M.J., García-Sanjuán, S., Escribano, S., Fernández-Alcántara, M., Martínez-Riera, J.R. and Juliá-Sanchís, R. (2021) Mixed-Method Study on the Satisfaction of a High-Fidelity Simulation Program in a Sample of Nursing-Degree Students. *Nurse Education Today*, **100**, Article ID: 104858. https://doi.org/10.1016/j.nedt.2021.104858

[44] Yuan, H.B., Williams, B.A. and Fang, J.B. (2012) The Contribution of High-Fidelity Simulation to Nursing Students' Confidence and Competence: A Systematic Review. *International Nursing Review*, **59**, 26-33. https://doi.org/10.1111/j.1466-7657.2011.00964.x

[45] Kaddoura, M.A., Van Dyke, O. and Yang, Q. (2017) Correlation between Critical Thinking Skills and National Council Licensure Examination for Registered Nurses Success in Accelerated Bachelor Nursing Students. *Teaching and Learning in Nursing*, **12**, 3-7. https://doi.org/10.1016/j.teln.2016.08.004

[46] Azizi-Fini, I., Hajibagheri, A. and Adib-Hajbaghery, M. (2015) Critical Thinking Skills in Nursing Students: A Comparison between Freshmen and Senior Students. *Nursing and Midwifery Studies*, **4**, e25721. https://doi.org/10.17795/nmsjournal25721

[47] Cant, R.P. and Cooper, S.J. (2010) Simulation-Based Learning in Nurse Education:

Systematic Review. *Journal of Advanced Nursing*, **66**, 3-15. https://doi.org/10.1111/j.1365-2648.2009.05240.x

[48] Adib-Hajbaghery, M. and Sharifi, N. (2017) Effect of Simulation Training on the Development of Nurses and Nursing Students' Critical Thinking: A Systematic Literature Review. *Nurse Education Today*, **50**, 17-24. https://doi.org/10.1016/j.nedt.2016.12.011

[49] Kelly, M.A., Forber, J., Conlon, L., Roche, M. and Stasa, H. (2014) Empowering the Registered Nurses of Tomorrow: Students' Perspectives of a Simulation Experience for Recognising and Managing a Deteriorating Patient. *Nurse Education Today*, **34**, 724-729. https://doi.org/10.1016/j.nedt.2013.08.014

[50] Beaird, G., Nye, C. and Thacker, L.R. (2017) The Use of Video Recording and Standardized Patient Feedback to Improve Communication Performance in Undergraduate Nursing Students. *Clinical Simulation in Nursing*, **13**, 176-185. https://doi.org/10.1016/j.ecns.2016.12.005

[51] Carson, P.P. and Harder, N. (2016) Simulation Use within the Classroom: Recommendations from the Literature. *Clinical Simulation in Nursing*, **12**, 429-437. https://doi.org/10.1016/j.ecns.2016.03.009

[52] Mulyadi, M., Tonapa, S.I., Rompas, S.S.J., Wang, R.H. and Lee, B.O. (2021) Effects of Simulation Technology-Based Learning on Nursing Students' Learning Outcomes: A Systematic Review and Meta-Analysis of Experimental Studies. *Nurse Education Today*, **107**, Article ID: 105127. https://doi.org/10.1016/j.nedt.2021.105127

[53] Burbach, B.E., Struwe, L.A., Young, L. and Cohen, M.Z. (2019) Correlates of Student Performance during Low Stakes Simulation. *Journal of Professional Nursing*, **35**, 44-50. https://doi.org/10.1016/j.profnurs.2018.06.002

[54] Taha, A.A., Jadalla, A., Bin Ali, W., Firkins, J., Norman, S. and Azar, N. (2021) Structured Simulations Improves Students' Knowledge Acquisition and Perceptions of Teaching Effectiveness: A Quasi-Experimental Study. *Journal of Clinical Nursing*, **30**, 3163-3170. https://doi.org/10.1111/jocn.15815

[55] Weaver, A. (2011) High-Fidelity Patient Simulation in Nursing Education: An Integrative Review. *Nursing Education Perspectives*, **32**, 37-40. https://doi.org/10.5480/1536-5026-32.1.37

[56] Seo, Y.H. and Eom, M.R. (2021) The Effect of Simulation Nursing Education Using the Outcome-Present State-Test Model on Clinical Reasoning, the Problem-Solving Process, Self-Efficacy, and Clinical Competency in Korean Nursing Students. *Healthcare*, **9**, Article 243. https://doi.org/10.3390/healthcare9030243

Appendix 1. Overview of Included Studies

	Author(s), year, location	Method Participants Setting	Study aims	Outcome measure, instruments, intervention	Results
1	**Al Gharibi *et al.* (2021) USA**	**Method:** A quasi-experimental one-group repeated measures design **Participants:** Junior level 3 students and senior level 4 (N = 126) **Setting:** College of Nursing and Health Professions in a private university located in the Midwest USA	Aim of the study was to assess the effect of repeated simulation experiences on self-efficacy among nursing undergraduate students.	- Self-efficacy - General self-efficacy (ten questions) - Using HF simulator	Findings of this study indicated that students' self-efficacy decreased following the first simulation but improved significantly after repeated simulations.
2	**Arslan *et al.* (2018) Turkey**	**Method:** A two-group non-randomised quasi-experimental study **Participants:** Third-year students (N = 227) **Setting:** Health Sciences faculties in Konya	Aims of the study were to determine the effectiveness of classical and simulation-based paediatric nursing training on nurse students' perceptions of self-efficacy and anxiety levels in clinical practice in Turkey.	- Self-efficacy, Anxiety - Demographic characteristics and perceived self-efficacy about paediatric practice skills for student (50 items) - State–Trait Anxiety Inventory (20 items) - Using simulation mannequin	Findings of this study indicate that simulation training positively increased the self-efficacy and reduced the anxiety of nursing students.
3	**Hung *et al.* (2021) Taiwan region**	**Method:** An experimental design using self-administered questionnaires with a one-group repeated measurement design **Participants:** senior students (N = 79). **Setting:** University simulation centre in southern Taiwan region	Aims of the study were to investigate the effects of repeated exposure to nursing simulations on nursing students' perceptions of their competencies, learning satisfaction and self-efficacy.	- Self-efficacy, nursing students', Competence, Satisfaction - Using LES (15 items) - Using SBLES (37 items) - Using LSS (8 items) - Using HFS	Findings of this study indicate that nursing students' competence, self-efficacy and educational satisfaction improve following repeated simulation training.
4	**Jørgensen *et al.* [34] Denmark**	**Method:** Controlled intervention study **Participants:** (N = 74) **Setting:** Hospital emergency department (ED)	Aims of the study were to evaluate the effect of clinical simulation in conjunction with theory-based lessons, as well as students' perceptions of the learning process and self-efficacy.	- Self-efficacy, Learning process, Knowledge - Self-efficacy questionnaire - Learning Rating Scale (LRS) - Using live actors - Role play and dummies	Findings of this study indicated that students' self-efficacy increased following the combination of traditional and simulation-based lessons.
5	**Karabacak *et al.* (2019) Turkey**	**Method:** Semi-experimental study **Participants:** First-year nursing students (N = 65). **Setting:** None	Aims of the study were to explore the impact of simulation-based learning on first-year nursing students' performance and self-efficacy.	- Self-efficacy, Performance - General Self-Efficacy Scale (GSE) (23 items). - Proficiency Assessment Form (PAF) (4 items) - Using a standardised patient	Findings of this study indicate student self-efficacy and proficiency decreased post exposure to simulation training.

Continued

6	**Kim (2018) South Korea**	**Method:** Using a two-group, cross-over quasi-experimental design **Participants:** Fourth-year students (N = 76). **Setting**: None	Aims of the study were to evaluate the effects of simulation education on nursing students' self-efficacy and critical thinking skills in emergency cardiac arrest.	- Self-efficacy, Critical thinking - Using a general self-efficacy subscale (17 items) - Using the Critical Thinking Skills Tool (27 items) - Using role play simulation and HFS	Findings of this study indicate that students' self-efficacy and critical thinking were increased following simulation training.
7	**Lee *et al.* (2016) Korea**	**Method:** A quasi-experimental study of non-equivalent control group pre-test–post-test design **Participants:** Senior nursing students (N = 49) **Setting:** Nursing college in Seoul	Aims of the study were to examine the effects of high-fidelity patient simulation on undergraduate nursing students' clinical reasoning skills.	- Problem solving, Academic self-efficacy, Nursing core competencies - Academic Self-efficacy Tool (28 questions) - Problem-solving Skills Assessment Tool (24 questions) - Core Competencies Measurement Tool (70 questions) - Using high-fidelity simulation	Findings of this study found that problem solving and academic self-efficacy were higher in the experimental group after HFPS led clinical reasoning, but no statistically significant differences were found. However, nursing core competencies did improve significantly.
8	**Mohamed and Fashafsheh (2019) Saudi Arabia**	**Method:** A quasi-experimental one-group pre-test–post-test design **Participants:** Third- and fourth-year undergraduate nursing students (N = 100) **Setting:** University of Bisha, Saudi Arabia	Aim of the study was to assess simulation-based training's effect on nursing students' self-efficacy, communication skills and clinical competence.	- Communication skill, Self-efficacy, Clinical competence - Using communication skill (CS) (ten questions) - Using GSE Scale (14 items) - Using Clinical Competence Scale (CCS) (24 questions) - Using moderate-fidelity medical and critical simulators	Findings of this study were that students' self-efficacy, communication skills and clinical competence were improved after participating in simulation training.
9	**Park *et al.* (2017) South Korea**	**Method:** Pre- and post-test, one-group intervention design **Participants:** Senior fourth-year undergraduate nursing students (N = 69) **Setting:** A university in Suwon	Aim of the study was to assess the impact of simulation teaching strategies applied to a nursing practicum based on the Jeffries Simulation Framework toward self-efficacy, critical thinking and motivation for learning among senior nursing students.	- Self-efficacy, Critical thinking, Learning motivation, Performance, satisfaction - Using GSE Scale (17 items) - Using Critical Thinking Disposition Scale (27 items) - Using Instructional Materials Motivation Scale (27 items) - Using skill performance test - Using LFS and HFS	Findings of this study indicate that simulation training significantly increases a student's self-efficacy, critical thinking and learning motivation.
10	**Roh *et al.* (2016) Korea**	**Method:** A single-group pre- and post-test design **Participants:** Second-year nursing students (n = 255) **Setting:** Simulation centre at a college of nursing	Aims of the study were to examine mastery learning and self-efficacy in nursing students through integrated simulation-based resuscitation skills training.	- Self-efficacy, Knowledge - Resuscitation Self-Efficacy Scale (17 items) - Using mannequins (Resusci Anne)	Findings of this study revealed that self-efficacy of nursing students significantly improved after the clinical practicum compared to baseline.

Continued

11	**Yeung (2019) Hong Kong SAR**	**Method:** A pre- and post-test design, a quasi-experimental study **Participants:** Fourth-year nursing students (N = 44). **Setting:** None	Aims of the study were to evaluate the effectiveness of two training approaches, simulated patient and peer role play, on nursing students' performance and self-efficacy in an AED simulation.	- Self-efficacy - Using self-efficacy questionnaire (11 items) - Using professional actors and peer role play	Findings of this study showed a significant difference in self-efficacy between the groups. However, no significant difference emerged between the groups in performance.

Appendix 2. The Result of SRR Quality Assessments Checklist

Author	Al Gharibi *et al.* (2021)	Arslan *et al.* (2018)	Hung *et al.* (2021)	Jørgensen *et al.* (2018)	Karabacak *et al.* (2019)	Kim (2018)	Lee *et al.* (2016)	Mohamed and Fashafsheh (2019)	Park *et al.* (2017)	Roh *et al.* (2016)	Yeung (2019)
Element of study Introduction background	4	4	4	4	3	4	3	4	4	3	3
Rationale Literature review	4	3	4	4	3	3	3	3	3	3	2
Problem statement Study objective Research Q.	3	3	3	4	3	3	4	4	3	3	3
Guiding concept or theoretical framework	3	0	0	0	0	0	3	0	4	0	0
Design of studies	4	4	4	3	2	4	4	3	3	3	3
Strength of study design: quantitative	3	3	4	4	2	3	3	3	2	2	3
Strength of study design: qualitative	0	0	0	0	0	0	0	0	0	0	0
Sample and setting	3	3	4	3	3	4	4	3	3	4	3
Simulation development	3	4	2	2	1	3	3	1	4	3	1
Description of simulation	4	4	3	3	3	3	3	3	4	4	3
Description of simulation feedback debriefing	4	2	3	2	3	2	3	2	4	3	3
Study instruments: quantitative	2	3	4	2	3	4	4	3	4	3	2
Study instruments: qualitative	0	0	0	0	0	0	0	0	0	0	0
Results	3	4	4	4	3	3	3	3	3	4	3
Discussion	4	4	4	4	4	4	3	3	4	3	3
IRB approval exemption: ethics	4	4	4	4	4	4	4	4	4	4	4
Total	48	45	43	39	37	44	47	39	49	42	36
Total percentage	86%	80%	77%	70%	66%	79%	84%	70%	87.5%	75%	64%

4 excellent, 3 very good, 2 good, 1 poor, 0 unsatisfactory. The maximum score possible for mixed qualitative and quantitative studies is 64, and the maximum possible score for either qualitative or quantitative studies is 56.