



## Review article

# Approaches for boosting self-confidence of clinical nursing students: A systematic review and meta-analysis

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## ABSTRACT

**Background:** Self-confidence is a key element in successfully promoting achievement strivings among the healthcare workforce. Targeted interventions can strengthen this characteristic in nursing students, thus improving the quality of hospital services.

**Objectives:** We evaluated the effect of educational interventions on boosting self-confidence in nursing students using systematic review and meta-analysis.

**Methods:** A comprehensive search was used to screen the related studies in Scopus, PubMed, Embase, Web of Science, and PsycINFO. Peer-reviewed literature in English until June 2023 was reviewed. Inclusion criteria were controlled trials, either non-randomized studies of intervention (NRSI) or randomized (RCTs). Studies were assessed for methodological quality by the Cochrane Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) and the Cochrane "Risk of Bias" tool for RCTs (RoB 2.0) and quality assessment tool for before-after (pre-post) studies with no control group. The main outcome was the self-confidence score of nursing students because of educational methods or intervention/s. Using the inverse variance weights method, a pooled standardized mean difference (SMD) estimate with a corresponding 95% confidence interval (CI) was determined. Random-effects meta-analysis was used to assess conceptual heterogeneity using Stata.

**Results:** Twenty-two studies were selected involving 1758 participants and 940 cases of nursing students in the intervention group on boosting self-confidence (Fourteen Randomized controlled trials, Five Quasi-experimental, and three Before-After studies). The post-intervention self-confidence results in the nursing student's intervention group were significantly greater (SMD) (SMD for Controlled experimental design = 0.51; 95% CI = 0.14–0.89), (SMD for Quasi-experimental = 0.04; 95% CI = -0.33–0.41), (SMD for Before-After (Pre-Post) = 2.74; 95% CI = 1.85–3.63). The random-effect meta-analysis of 22 interventional studies determined that educational interventions are significantly associated with the improving self-confidence of nursing students. The intervention showed a moderate impact on the research units, according to Cohen's d results.

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Also, the results of simulation learning intervention (SMD = 0.42; 95% CI = 0.03–0.81) showed a significant relationship between intervention and outcome in studies.

*Conclusions:* Analysis of our findings revealed the successful impact of most interventional approaches in boosting self-confidence, especially in the long term. It can be concluded that self-confidence is a multifactorial concept that can be improved by using targeted combination intervention strategies.

## 1. Introduction

Clinical education is a critical component of nursing education and is often considered the cornerstone of professional development [1,2]. Universities worldwide are currently exploring teaching-learning strategies that foster clinical thinking, decision-making, and student-centered learning within the clinical setting [3]. In many cases, clinical education accounts for approximately half of the training time for nursing students. Therefore, it is essential that all students are able to proficiently apply the skills they have learned upon completion of their studies [4]. One influential factor in enhancing the quality of clinical services is the presence of self-confidence in both students and educated nurses. Self-confidence is integral to clinical competence and serves as an important indicator of ability and proficiency [5]. Self-confidence can be defined as an indication of a belief in one's individual abilities and skills. It plays a crucial role in a student's judgment, performance, and knowledge translation [6]. By building self-confidence, nursing students can achieve improved academic performance, job satisfaction, enhanced communication, and the capacity for more independent practice. This, in turn, positively impacts individuals receiving nursing care [7,8].

On the other hand, previous academic and clinical experiences provide students with the self-confidence and competence necessary to handle everyday situations. However, the complex and delicate healthcare environment poses unique challenges for nursing students [9]. These challenges may lead to anxiety and stress, hindering the successful performance of clinical procedures [10]. Thus, it is crucial for nursing students to possess adequate knowledge and practical skills before commencing clinical practice. This not only ensures patient safety but also fosters self-confidence and fosters effective relationships with patients [11]. Therefore, nurse educators must continually identify, implement, and evaluate teaching-learning strategies that promote the development of students' clinical competence and self-confidence [12]. Identifying and formulating these strategies is a significant challenge for nursing educators seeking to enhance nursing students' skills, self-confidence, and knowledge [13].

Therefore, appropriate approaches and interventions in teaching clinical skills need to be adopted for better success of nursing students in their profession and to improve and enhance their self-confidence and increase their professional competence. However, how effective are the interventions used in improving the self-confidence of clinical nursing students? Or what is the change in self-confidence of clinical nursing students following the use of relevant educational interventions? Due to the scant of a review and coherent study, we evaluated the effect of educational interventions on boosting self-confidence in nursing students using systematic review and meta-analysis. The results of this study will pave the way for improvements in clinical nursing education. The implementation of the identified strategies has the potential to reduce stress, enhance self-confidence, improve functional ability, and foster feelings of satisfaction and well-being among nursing students.

## 2. Methods

### 2.1. Protocol registration

The current meta-analysis was done based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and the Cochrane Handbook for Systematic Reviews of Interventions (Version 5.3) guidelines. This meta-analysis was registered in the International Prospective Register of Systematic Reviews (PROSPERO; CRD42023466725).

### 2.2. Search strategy

The online databases including PubMed, Web of Science (ISI), Embase, PsycINFO, and Scopus were searched systematically until June 2023, to identify relevant interventional studies. A mixture of the Medical Subject Headings (MeSH) and non-MeSH keywords were applied to retrieve studies because of increasing sensitivity and specificity. The following keywords were chosen: "self-concept" OR "self-perception" OR "self-efficacy" OR "self-confidence" AND "nursing students" as MeSH terms. In the following, Google Scholar and references list of retrieved studies and reviews were also searched for additional pertinent studies. Duplicate studies were excluded using EndNote software.

### 2.3. Eligibility criteria

#### 2.3.1. Types of studies

This review was focused on interventional studies, such as randomized controlled trials (RCTs) and non-randomized controlled studies or quasi-experimental, and before-after studies. The inclusion criteria were original articles in English, year of publication until June 2023. Also, we specifically looked for studies that used methods or intervention/s either in a clinical or theory class setting, with

self-confidence as the main variable.

2.3.2. *Types of participants*

Individuals, who were undergraduate nursing students and have learned clinical methods in the academic environment under the supervision of a mentor or clinical educator.

2.3.3. *Types of interventions*

All educational methods or intervention/s used to promote self-confidence in clinical nursing students were included.

2.3.4. *Types of comparators*

Relevant traditional clinical training and education were taken into consideration in the comparator group.

2.3.5. *Outcome measures*

The main outcome was changes in the self-confidence score of nursing students as measured by validated tools following educational methods or intervention/s.

2.3.6. *Exclusion criteria*

Animal experiments, observational studies; case reports, case series, editorials, literature reviews, conference proceedings; commentaries; insufficient original data, and duplicated publications were excluded.

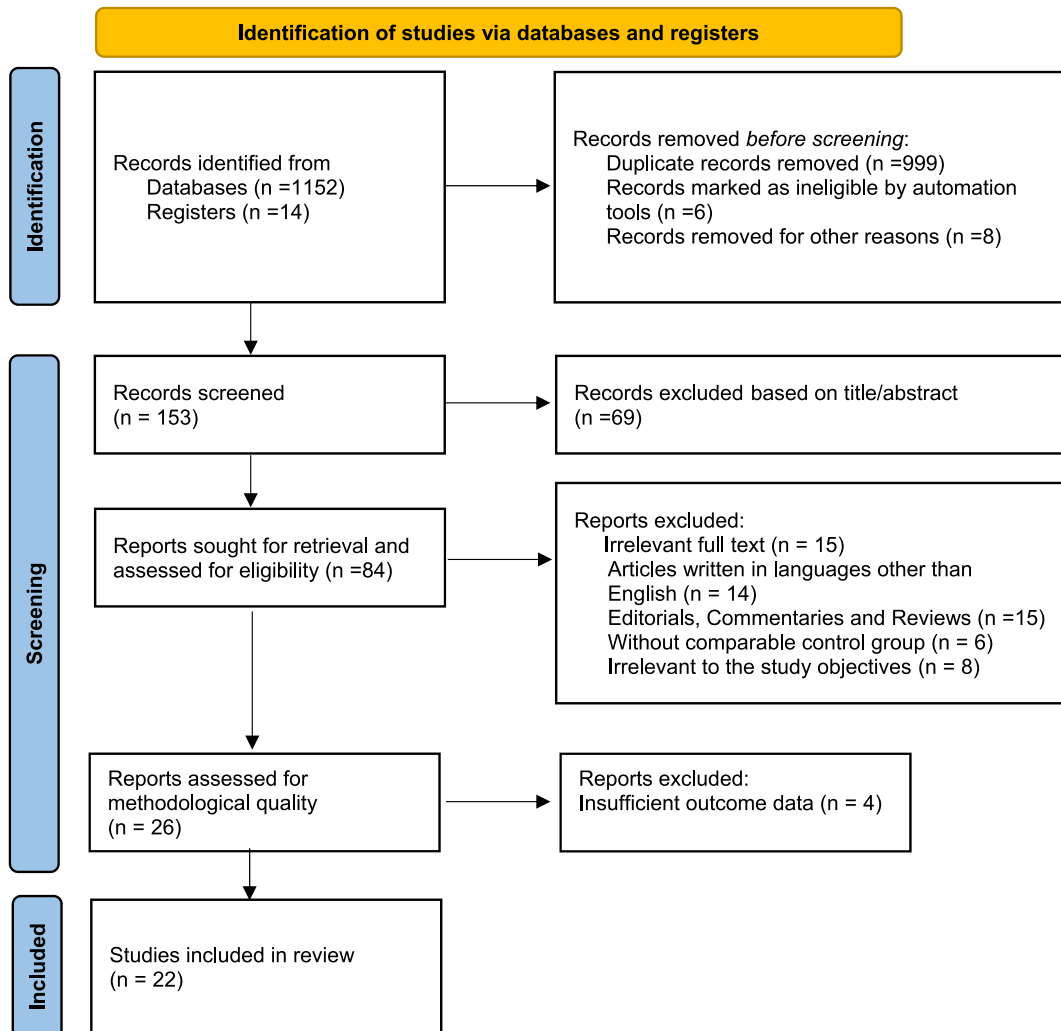


Fig. 1. Flow diagram of review process (PRISMA).

2.4. Selection studies

In the initial step, the two reviewers (ERT and FHN) independently reviewed the title and abstract of searched articles to select relevant items in accordance with inclusion and exclusion criteria. This process, facilitated by EndNote software (version X.9.3.3), resulted in the initial selection of 84 potentially relevant articles. In the second step, the full text of these articles was reviewed to identify studies meeting the inclusion criteria, resulting in the selection of 22 relevant articles. Fig. 1 illustrates the study selection process as per the PRISMA guidelines [14].

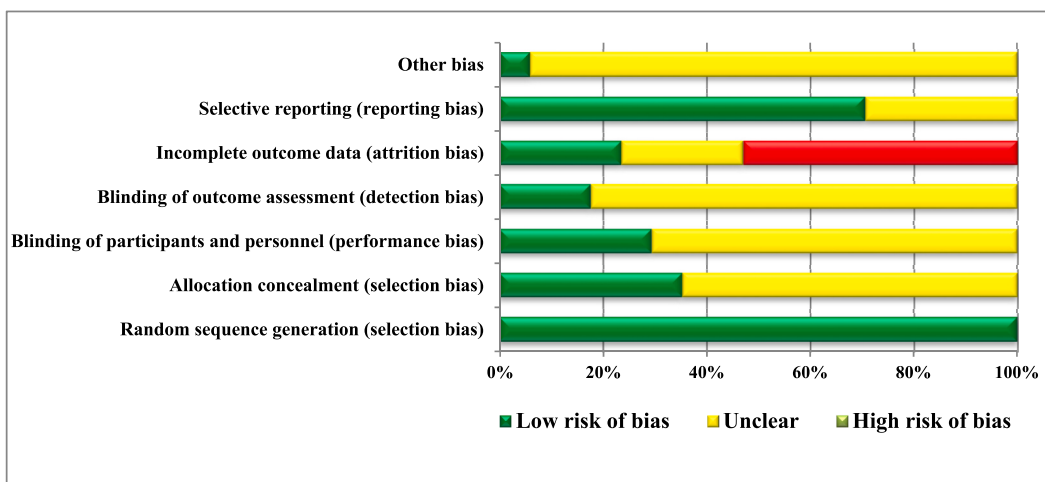
2.5. Quality assessment of included studies

The risk of biases in the included studies was evaluated using the updated Cochrane "Risk of bias" tool for RCTs (RoB 2.0), the Cochrane Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool, and the quality assessment tool for before-after (pre-post) studies without control group designed by the National Heart, Lung, and Blood Institute (NHLBI).

For randomized trials, the RoB 2.0 tool considers five following domains: (1) the randomization process, (2) missing data outcome, (3) interventions, (4) outcome measurement and (5) selection of the result. The domains are rated as low, some concern, or high risk, and the overall assessment of bias risk is assigned to each study [15]. The ROBINS-I tool is a valid tool to assess the quality of non-randomized studies, was used for Non-randomized Study Intervention (NRSI) studies and can assess the risk of bias in domains such as subject selection, missing data, confounding risk, variations from intended interventions, outcome measures, intervention classification, and selective reporting. Each domain is classified as low, moderate, serious, or critical risk, and an overall assessment of bias risk is provided for each study [16]. The tool to assess quality for before-after (pre-post) studies without a control group, designed by NHLBI was applied and included 12 items. Reviewers could select no, yes, or cannot determine (CD)/not applicable (NA)/not reported (NR) in response to each item. The study is then rated as either good, fair, or poor quality based on the ratings of the different items and the presence of flaws in the study implementation or design [17].

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Abarca, 2023	+	+	+	+	+	+	+
Alamrani, 2017	+	?	?	?	?	-	?
Brown, 2009	+	?	?	?	?	?	?
Chuang, 2018	+	?	?	?	?	+	?
Erenel, 2021	+	?	?	?	+	-	?
Horsley, 2015	+	?	?	?	?	?	?
Liaw, 2012	+	+	+	+	?	?	?
Liu, 2021	+	+	?	?	-	-	?
Meska, 2018	+	?	?	?	+	+	?
Secheresse, 2020	+	?	?	?	?	?	?
Svellingen, 2021	+	+	?	?	-	-	?
Tawalbeh, 2013	+	+	+	?	-	+	?
Tawalbeh, 2016	+	?	?	?	?	?	?
Altun, 2022	+	?	?	?	?	-	?
Sarvan, 2022	+	+	+	+	-	+	?
Chang, 2021	+	?	?	?	+	-	?
Brannan, 2016	+	?	+	?	?	+	?

Fig. 2. A Risk of Bias Summary (ROB tool). BRisk of bias graph (ROB tool) Domains. C. Risk of bias summary (ROBINS-I).



B

Study	D1	D2	D3	D4	D5	D6	D7	Overall judgment
Bektaş, 2017	⊗	+	+	+	-	-	+	⊗
Blum, 2010	-	+	+	+	-	-	+	-
Brannan, 2009	⊗	+	+	+	-	-	+	⊗
Needham, 2005	⊗	-	+	+	-	⊗	⊗	⊗
Park, 2018	-	+	+	+	+	+	+	+

Domains:

- D1: Bias due to confounding
- D2: Bias in selection of participants
- D3: Bias in classification of interventions
- D4: Bias due to deviations from intended interventions
- D5: Bias due to missing data
- D6: Bias in measurement of outcomes
- D7: Bias in selection of the reported result

Judgement:

- ⊕ Low
- Moderate
- ⊗ Serious

C

Fig. 2. (continued).

2.6. Data extraction

The data retrieved from the searches was imported into Endnote, and duplicates were removed. Two reviewers independently screened the title and abstract and a third reviewer was available to resolve any disputes.

Data extraction was performed by two authors (ERT and MS) by a predesigned and standardized data extraction form and recorded the data in a Microsoft Excel sheet. The following information was considered in the data extraction: 1. study's characteristics and bibliography including first author, year of publication, country, study design, duration, and method of measuring self-confidence. 2. Sample characteristics include the sample size, gender, age, etc. 3. Interventions and comparisons, such as the other method/interventions for education for nursing students 4. Results of studies include the mean and standard deviation (SD) of the control group and experimental group. If any study data was unclear or missing, the corresponding author was contacted via email.

2.7. Statistical analysis

The calculation of the pooled standardized mean difference with 95% confidence intervals (SMD with 95% CI was utilized as efficiency outcome pooled estimation) was done to visually inspect the trials by forest plots to test for heterogeneity. A random-effects meta-analysis was performed to take account of the heterogeneity of the research's populations because of conceptual heterogeneity. Inverse-variance weights were used to obtain the pooled estimates and their associated 95% CIs.

We evaluated heterogeneity among studies by the I<sup>2</sup> statistic [18] (I<sup>2</sup> = 0% shows no heterogeneity while I<sup>2</sup> ≥ 50% shows

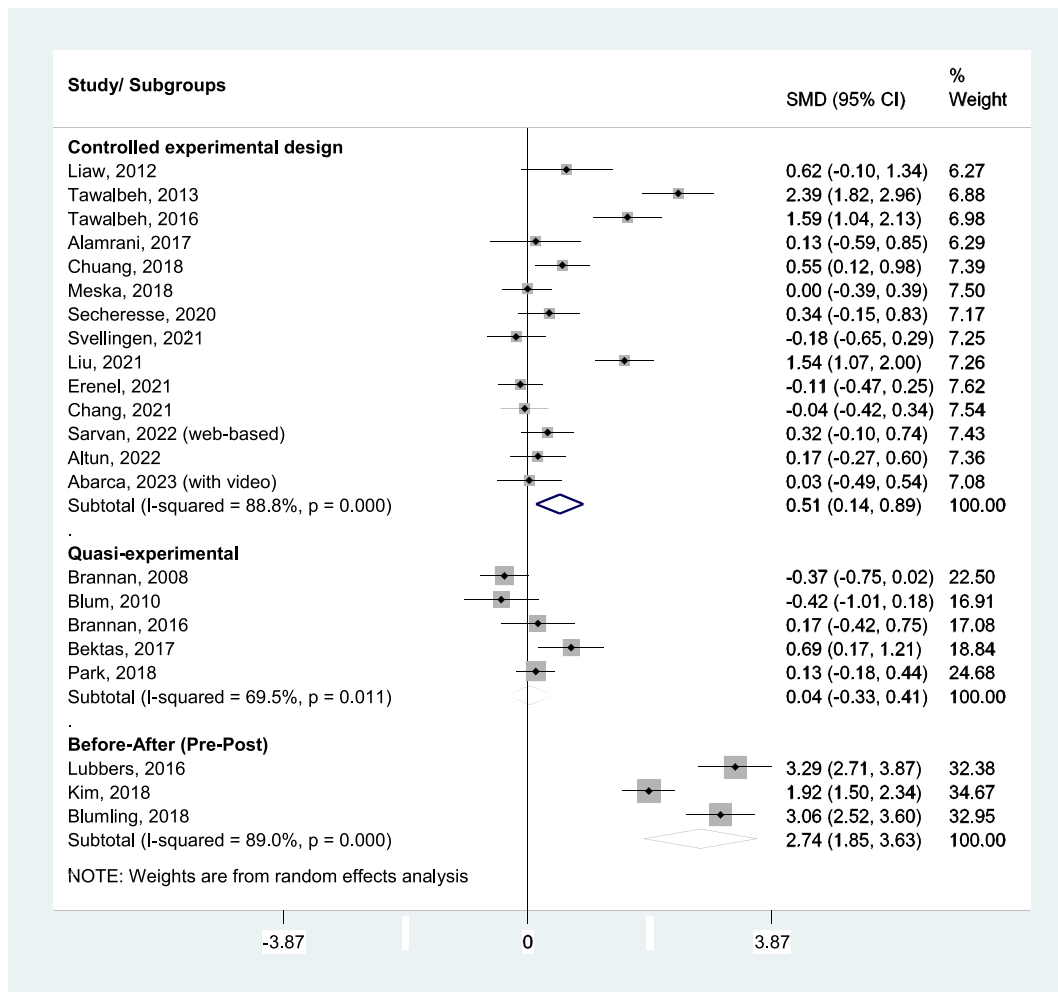
substantial heterogeneity). The statistical significance of heterogeneity was also examined using Cochran’s Q statistic. To establish which research had the most effect on the heterogeneity and evaluate the robustness of pooled estimates, sensitivity analysis was carried out (Fig. 2) [19,20]. On the basis of the type of study design, subgroup analyses were conducted.

To evaluate publication bias, funnel plots were visually inspected (Fig. 3). The adjusted rank correlation test and Egger’s regression asymmetry test were used for formal statistical assessments of funnel plot asymmetry. Begg’s adjusted rank correlation test and the trim-and-fill method were also used [21,22]. The SMD was plotted against the square root of the standard error inverse. All statistical tests, except for the heterogeneity test, were two-tailed and a significance threshold of less than 0.05 was set. Stata version 17.0 was used for statistical analyses.

### 3. Results

#### 3.1. Study characteristics

Using a comprehensive literature search, 1166 studies were identified as relevant. After removing duplicate studies and screening abstracts and titles, 153 studies were selected for an in-depth full-text review. Twenty-six Studies had pre-determined eligibility criteria to be included in the systematic review. Finally, 22 studies (fourteen RCTs, five Quasi-experimental, and three before-after studies) were considered in the meta-analysis. These studies reported the self-confidence scores of nursing students as the main outcome, with complete statistical data on 1758 participants and 940 nursing student cases in the intervention group for boosting self-



**Fig. 3.** Forest plot of studies that investigated the influence of educational interventions on boosting the self-confidence (separated by study designs). Diamond represents the summary standardised mean difference (pooled SMD) estimate and its width shows corresponding 95% CI with random effects estimate. The size of the square and its central point reflects the study specific statistical weight (inverse of variance) and point estimate of the SMD and horizontal line reflects corresponding 95% CI of the study. I<sup>2</sup> test and Cochran’s Q statistic were used to assessing the statistical heterogeneity (P < 0.10) across studies.

**Tables 1**

Main Characteristics of the included studies on self-confidence-related interventions among nursing students.

Authors, year, country	Interventions	Purpose	Study Design	Instrument	Sample size	Result
Abarca et al., 2023, Brazil	Simulation learning with video	To identify the effect on satisfaction and self-confidence of undergraduate nursing students after using a validated bed bath video during the simulation.	Randomized controlled trial	Self-Confidence with Learning Scale	58	There was no significant difference between the groups regarding satisfaction and self-confidence.
Alamrani et al., 2018, Saudi Arabia	Simulation learning	To compare the effect of simulation-based and traditional teaching methods on the critical thinking and self-confidence of Nursing students during electrocardiogram interpretation sessions	Randomized controlled trial	Confidence Scale (C-scale)	30	There was no significant difference between the results of the simulation method and those of the traditional teaching method, which suggests that the outcomes depend on how well the traditional or modern teaching programs are implemented. There was no statistically significant difference between the two groups in terms of the scores obtained from the Students Satisfaction and Self-Confidence in Learning Scale and its subscales. Compared to the low-fidelity mannequin group, the standardized patient group obtained higher scores from the Simulation Design Scale and its Objectives/Information subscale.
Altun et al., 2022, Turkey	Simulation learning	To compare the impact of standardized patient and low-fidelity simulation methods on the success, satisfaction, and self-confidence levels of nursing students in prevention and management of pressure injury education.	Randomized controlled trial	Self-Confidence with Learning Scale	81	The web-based program increased the students' confidence by 17.8%
Bektaş et al., 2017, Turkey	Web-based education	To investigate the effect of web-based teaching on paediatric nursing internship students' self-confidence and anxiety levels in the clinical decision-making process	Quasi-experimental	Nursing Anxiety and Self-confidence with Clinical Decision-making Scale	61	The simulation technique generally improved the students' confidence and competence during the semester, but did not significantly increase their competence in performing care techniques.
Blum et al., 2010, USA	Simulation learning	To examine of the quantitative relationship between simulation, student self-confidence, and clinical competence in high-fidelity patient simulation	Quasi-experimental	Lasater Clinical Judgment Rubric	53	There was a statistically significant increase in confidence from pretest to post lecture,
Blumling et al., 2018, USA	Standardized Patient Simulation	To evaluate a standardized patient simulation experience depicting a victim of Intimate partner violence on undergraduate nursing student knowledge and confidence in assessment and intervention of Intimate partner violence.	Before-After	The Physician Readiness to Manage Intimate Partner Violence Survey	57	The assertiveness technique training had a significant effect on the self-confidence of students in the intervention group.
Brannan et al., 2008, USA	Simulation learning	To compare the effectiveness of two instructional methods on junior-level nursing students' cognitive skills and self-confidence	Quasi-experimental	Confidence Level tool (CL)	22	There was no significant difference between learning styles in terms of students' confidence or knowledge in either simulation or traditional classroom methods.
Brannan et al., 2016, USA	Learning styles Felder and Soloman's (2004) Simulation	To examine learning styles and outcomes on Knowledge and self-confidence in nursing students in simulation and classroom	Quasi-experimental	Confidence Level tool (CL)	54	

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Tables 1 (continued)

Authors, year, country	Interventions	Purpose	Study Design	Instrument	Sample size	Result
Chang et al., 2021, Taiwan	Simulation-based nursing process	To examine the effects of a simulation-based nursing process educational program on nursing students' confidence in communication and foundational understanding of the nursing process.	Randomized controlled trial	Confidence in Communication self-assessment survey	107	Both groups showed statistically significant improvement in Confidence in Communication. The experimental group performed better on the assignment than the control group.
Chuang et al., 2018, Taiwan	Skill demonstration video delivered by smartphone	To examine the effects of a skill demonstration video delivered by smartphone on facilitating nursing students' nursing skill competency and confidence.	Randomized controlled trial	Confidence in Communication self-assessment survey	90	After 2 weeks, there was a significant difference between the intervention and control groups in terms of knowledge and skill scores, but not in terms of self-confidence.
Erenel et al., 2021, Turkey	Scenario-Based Simulation	To determine the effect of simulation practices on clinical practice satisfaction, clinical stress, and self-confidence in nursing students.	Randomized controlled trial	Self-confidence scale	122	In contrast, no mean pretest–posttest differences were found in clinical stress and self-confidence levels in the experimental group.
Kim et al., 2018, South Korea	Neonatal nursing practice program	To examine the effects of a neonatal nursing practice program for nursing students on students' stress, self-efficacy, and confidence	Before-After	Researcher-developed questionnaire	64	The neonatal nursing practice program was effective at decreasing clinical practice-related stress and increasing confidence and self-efficacy regarding neonatal nursing practice.
Liaw et al., 2012, Singapore	Simulation learning	To determine simulation-based assessment on self-confidence, knowledge measures, and clinical performance	Randomized controlled trial	Confidence Scale (C-scale)	31	In both groups, post-test self-confidence scores were significantly different from pre-test scores, but there was no significant difference between the two groups. There was no significant relationship between self-confidence and clinical performance and between knowledge and clinical performance.
Liu et al., 2021, Taiwan	Multidisciplinary teaching	To design a multidisciplinary teaching method that combines game-based learning with a clinical situation-based teaching program and to test learning motivation, learning satisfaction and self confidence	Randomized controlled trial	3 items related to the multidisciplinary teaching questionnaire	98	Multidisciplinary teaching interventions can improve learning satisfaction, self-confidence and learning performance among nursing students.
Lubbers et al., 2016, USA	Pediatric community simulation learning	To determine the effects of a pediatric community simulation experience on the self-confidence of nursing students.	Before-After	Researcher-developed questionnaire	54	The overall study showed statistically significant results and statistically significant results within each of the eight 4-item subscales. Higher self-confidence scores for simulation participants have been shown to increase quality of care for patients.
Meska et al., 2018, Brasil	Simulation learning with odors	To compare the satisfaction and self-confidence of nursing students in simulated clinical activities with and without the presence of odors.	Randomized controlled trial	Self-Confidence with Learning Scale	100	In the comparison of means there were no significant differences between the values attributed to satisfaction and self-confidence, in the

(continued on next page)



Tables 1 (continued)

Authors, year, country	Interventions	Purpose	Study Design	Instrument	Sample size	Result
Park et al., 2018, South Korea	Intensive clinical skills course	To identify the effect of an intensive clinical skills course for senior nursing students on their self-confidence and clinical competence	Quasi-experimental	A tool developed by Bang and Kim (2014)	162	intervention group and in the control group Special clinical skills training had a significant positive effect on the self-confidence and clinical competence of nursing students in performing clinical nursing skills.
Sarvan et al., 2022, Turkey	Game simulation (SGS) into neonatal resuscitation training	To determine the impact of integrating serious game simulation (SGS) into neonatal resuscitation training on the neonatal resuscitation related knowledge, skills, satisfaction with training, and self confidence in learning of nursing students.	Randomized controlled trial	Self-Confidence with Learning Scale	90	The score averages of the Student Satisfaction and Self-Confidence in Learning Scale and its sub-dimensions were high for both groups.
Secheresse et al., 2020, France	Simulation debriefing modalities	To compare explicit, highly guided debriefing with implicit and low-guided debriefing in nurse education.	Randomized controlled trial	Researcher-developed questionnaire	136	Linear regression analysis showed that knowledge learning was higher in the debriefing conditions in which the analysis was carried out in an explicit manner. There was no debriefing type effect on self-efficacy and self-confidence increase.
Svellingen et al., 2021, Norway	Scenario-Based Simulation	To assess the effect of multiple simulations on the students' self-reported clinical decision-making skills and self-confidence.	Randomized controlled trial	Self-Confidence Scale	146	The results showed no significant differences between double vs single scenario sessions on clinical decision-making scores or self-confidence score. However, the overall self-confidence scores increased significantly over time.
Tawalbeh et al., 2013, Jordan	Simulation learning	To examine the effect of simulation on nursing students' knowledge of ACLS, knowledge retention, and self-confidence in applying ACLS skills	Randomized controlled trial	Researcher-developed questionnaire	100	The simulation-based training was significantly more effective than traditional training in improving the knowledge, performance, and self-confidence of nursing students in ACLS.
Tawalbeh et al., 2016, Jordan	Simulation learning	To test the effect of simulation on the confidence of university nursing students in applying heart and lung physical examination skills	Randomized controlled trial	Heart and lung assessment confidence scale	69	A paired <i>t</i> -test showed that confidence was significantly higher in the posttest than in the pretest for both groups. An independent <i>t</i> -test showed a statistically significant difference between the two groups in terms of the difference between the first posttest and second posttest scores for confidence in applying physical examination skills.

confidence (Fig. 1).

Five studies were conducted in the USA [9,23–26], nine in Asia (Taiwan, Jordan, South Korea, Singapore, and Saudi Arabia) [27–35], and six in Europe (Turkey, France, Norway) [36–41], and two in Brazil [41,42]. Seventeen studies included simulation learning [9,23–26,28,30,31,34–42], three studies included learning-teaching methods based on the course plan [29,32,33], one study included a skill demonstration video delivered by smartphone [27] and one included Web-based education [36]. The studies used different self-confidence measurement tools, with the Self-Confidence with Learning Scale [37,41,42], Confidence Level tool (CL) [24, 25], Confidence in Communication Self-Assessment Survey [27,28], and Confidence Scale (C-scale) [34,35] being the most commonly

used. Table 1 indicates a summary of the characteristics of the selected articles.

### 3.2. Quality assessment of selected studies

The methodological quality of 26 studies was assessed. Seventeen randomized controlled studies were evaluated by the RoB 2 risk of bias tool, and the RCTs were found to moderate the risk of bias (Fig. 2-A, Fig. 2-B). All RCT studies based on the Rob 2 tool were low risk in Random sequence generation (selection bias) and the majority of studies (more than 70%) were unclear or high risk in Incomplete outcome data (attrition bias). The ROBINS-I tool showed that 5 NRSIs had a Low risk of bias (Fig. 2-C). According to the results of ROBINS-I's tool, five non-randomized studies had a low risk of bias in Bias in the classification of interventions and Bias because of deviations from considered interventions, and a high risk of Bias because of confounding. Four pre-post studies by the Quality Assessment Tool for Before-After (Pre-Post) Studies with no control group, were determined to have good quality for methodological quality assessment, but all the before and after studies did not report data in the group-level interventions, follow-up rate, and blinding of outcome assessors, and individual-level outcome efforts. (Table 2).

### 3.3. Interventions

The interventions used in the included studies for boosting self-confidence among nursing students are discussed below.

#### 3.3.1. Simulation learning

Simulation is an activity that replicates the clinical environment reality and is designed to demonstrate decision-making, procedures, and critical thinking through various methods and tools. In nursing education, simulation can be in the form of fixed mannequins, patient role-playing scenarios, or computer software-connected mannequins. Simulators include not just mechanical devices, but also any role-playing, scenario, or case study. Although simulation has different levels, evidence shows that it is more efficient and effective than traditional teaching and lecture-based methods [23,35,43,44]. The purpose of simulation learning is to alleviate certain psychological problems or boost self-confidence. Out of the 17 studies employing this intervention, 7 studies found no significant association between the outcome and intervention [25,34,35,37,39,41,42], while others reported a strong association between the outcome and intervention [9,23,24,26,28,30,31,36,38,40].

#### 3.3.2. Web-based education

The self-confidence of students was significantly boosted using web-based education interventions, where courses were introduced and registered. In these courses, a homework module was used to provide homework, and students would upload their completed homework to the system. Quiz and test modules were available for students to take exams and complete all required forms. The source module allowed for uploading notes, videos, and PowerPoint presentations. The website contents, as well as videos and presentations prepared by instructors, were accessible to the students [45]. Only one out of the 22 studies focused on the web-based intervention and its effect on self-confidence [10].

#### 3.3.3. Video delivered by smartphone on skill demonstration

One of the most effective ways to provide educational materials to nursing students is through smartphones. In this intervention, no significant difference was detected in the level of self-confidence among students, but there was an improvement in their skills and knowledge. Both groups were given a DVD demonstration, with identical video clips available on smartphones and DVDs.

**Table 2**

Quality assessment for before-after (pre-post) studies with No control group.

Study	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Q 12
<b>Blumling, 2018</b>	Yes	NR	Yes	Yes	No	Yes	Yes	NR	NR	Yes	Yes	NR
<b>Kim, 2018</b>	Yes	Yes	Yes	Yes	NR	Yes	Yes	NR	NR	Yes	NA	NR
<b>Lubbers, 2016</b>	Yes	Yes	Yes	Yes	No	Yes	Yes	NR	NR	NR	NR	NR
<b>Saied, 2017</b>	Yes	Yes	Yes	Yes	No	Yes	Yes	NR	NR	Yes	NR	NR
Question 1	Study question, Was the study question or objective clearly stated?											
Question 2	Eligibility criteria and study population											
Question 3	Study participants representative of clinical populations of interest											
Question 4	All eligible participants enrolled											
Question 5	Sample size; Was the sample size sufficiently large to provide confidence in the findings?											
Question 6	Intervention clearly described											
Question 7	Outcome measures clearly described, valid, and reliable											
Question 8	Blinding of outcome assessors											
Question 9	Follow-up rate											
Question 10	Statistical analysis											
Question 11	Multiple outcome measures											
Question 12	Group-level interventions and individual-level outcome efforts											

\*NA, not applicable; NR, not reported.

Additionally, text messages were sent to both groups via smartphones three times a week to remind and encourage them to watch the videos. Post-test data were collected two weeks after the pre-test step [27].

### 3.4. Meta-analysis

The control and intervention groups were comparable because there was no significant difference in mean scores before the intervention across studies. However, the post-intervention result in the intervention group was significantly greater (Standardized Mean Difference [SMD]) (SMD for Controlled experimental design = 0.51; 95% CI = 0.14–0.89), (SMD for Quasi-experimental = 0.04; 95% CI = -0.33-0.41), (SMD for Before-After (Pre-Post) = 2.74; 95% CI = 1.85–3.63)). Therefore, the random-effects meta-analysis of 22 interventional studies showed that educational interventions were significantly associated with improving nursing students’ self-confidence. The interventions had a moderate impact on the research units, as indicated by Cohen’s d results. Furthermore, the positive SMD values in all studies confirmed consistent findings (Fig. 3).

Considering that most studies used simulation learning interventions, we conducted a separate analysis specifically on this common intervention. Based on the analyses performed, the SMD value was estimated to be 0.42 with a 95% CI ranging from 0.03 to 0.81. Despite the absence of a significant relationship between the intervention and outcome in some studies, the aggregated results demonstrated a significant relationship. According to Cohen’s d effect size table, the impact of this intervention falls within the medium range (Fig. 4).

The sensitivity analysis consistently showed a mean change in self-confidence within a range of summary SMDs: 0.31 to 0.46. This indicates that the meta-analysis model was robust. To investigate the possibility of publication bias, a Funnel plot was used. This plot displays the weighted mean difference against the standard error, which represents the level of study accuracy. A relatively small asymmetry was observed in the plot, suggesting the presence of publication bias (Fig. 5).

Further analysis by Egger statistical test and Begg’s adjusted rank correlation, as well as plot visual inspection, reinforced the suspicion of publication bias. However, we used the Trim and Fill approach with a random-effects model (Fig. 6). The findings of this method were consistent with the classical meta-analysis results, verifying each other’s results. Moreover, no additional studies were found through the trim and fill method. These findings indicate a comprehensive search of all eligible studies in the databases.

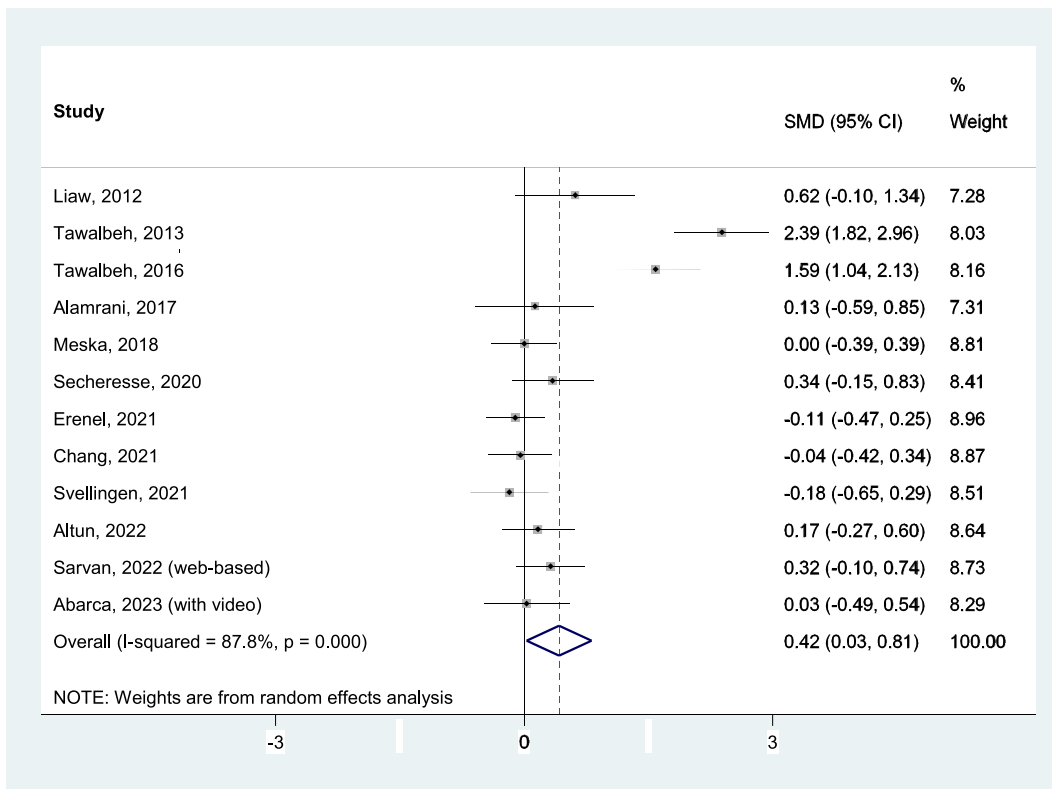
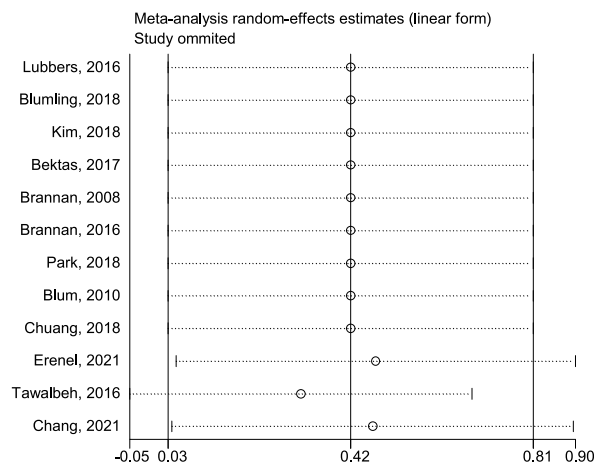
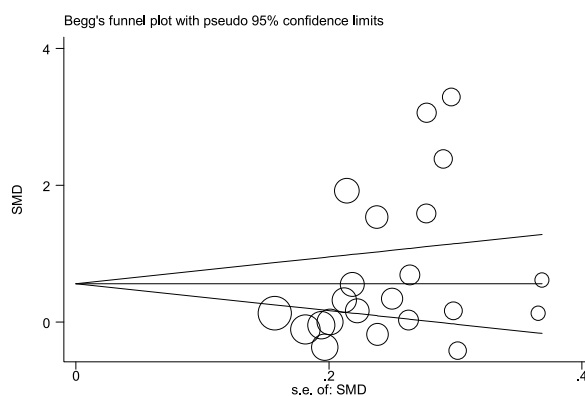


Fig. 4. Meta-analysis of the Simulation-based education interventions vs traditional approaches on boosting the self-confidence in nursing students (controlled experimental studies). Diamond represents the summary standardised mean difference (pooled SMD) estimate and its width shows corresponding 95% CI with random effects estimate.



**Fig. 5.** Sensitivity analysis of the Simulation-based education interventions vs traditional approaches on boosting the self-confidence in nursing students (controlled experimental studies).



**Fig. 6.** Begg's funnel plot for assessing the presence of publication bias. Weighted mean difference was plotted against the precision of the study ( $p = 0.03$ , for Begg's adjusted rank correlation test and  $p = 0.06$ , for Egger's regression asymmetry test).

#### 4. Discussion

Our study is the first systematic review and meta-analysis investigating the effect of various interventions on increasing the self-confidence of clinical nursing students. Self-confidence is a subjective and acquired factor that can be influenced by various factors, like role, sense of self, perspective, sense of efficacy self-esteem, and experiences related to the context or setting [6]. However, there are interventions that can significantly affect self-confidence.

Self-confidence is recognized as a central element in the success of practice and education for nursing students. Therefore, it is important to address self-confidence through organizational and individual interventions worldwide. A wide range of interventions can provide appropriate approaches to boost self-confidence. The present systematic review evaluated the effect of educational interventions on boosting nursing students' self-confidence. The interventions analyzed in the included articles consisted of simulation learning, videos provided by smartphones, and web-based education. The majority of these interventions had positive effects on boosting self-confidence and improving mental health. Simulation learning, in particular, is a practical method that can have a more effective impact by using models closest to the clinical situation. Additionally, this type of intervention can be performed in the nurses' own work environment, making it more efficient. In our review, high-fidelity simulation (HFS) was employed as a potent instrument to identify teaching-learning strategies among nursing students. However, some studies reported a neutral effect of this intervention. While HFS was found to improve competence and self-confidence in students, it was unable to boost caring parameters [44]. Further studies are needed to identify educational approaches that can enhance students' competence and self-confidence in the clinical environment.

In a study comparing conventional and simulation-based teaching techniques in undergraduate nursing students, significant results were not achieved after a single simulation session [46]. However, when both educational methods were used effectively, the self-confidence and critical thinking abilities of nursing students were strengthened successfully [47]. Nursing educators should be encouraged to develop training programs specifically designed to boost self-confidence and critical thinking ability [10]. It is

important to note that some studies found a significant impact of simulation interventions on self-confidence. In these studies, the self-confidence and knowledge of students in the intervention group were significantly enhanced in comparison to the control group [39]. Other studies also revealed the positive impacts of simulation on clinical learning, self-confidence, intimate partner violence, and decision-making skills [24,26,40]. Simulation learning has also shown effectiveness in directing nursing students toward the acquisition of knowledge and critical thinking for learning CPR (Cardiopulmonary resuscitation) [33]. Further research is needed to completely understand the self-confidence concept in the context of simulation learning and assess the role of the nurse educator in the simulation and clinical setting in promoting and developing self-confidence in prelicensure nursing students. The web-based education has effectively enhanced self-confidence levels and reduced nursing students' anxiety levels in clinical decision-making courses. Computer-assisted and other educational methods have had a positive influence on the self-confidence of nursing students in the clinical decision-making course [48,49]. The results of studies have demonstrated the suitability of delivering learning content via smartphones to nursing students. Although no significant difference was observed in the self-confidence of nursing students, their skills and knowledge were boosted through the intervention. Therefore, smartphones can be considered a complementary and useful tool for learning nursing skills. No significant differences were detected in the post-intervention self-confidence of nursing students between the groups, although their skills and knowledge had been enhanced. In line with these findings, previous studies observed no significant difference in nursing students' self-confidence levels while performing urinary catheterization for female and male patients between the intervention (iPods) and control (no technology) groups [32].

#### 4.1. Limitations

Our findings should be interpreted cautiously in the context of the limitations of the available data. Few studies have employed similar interventions, so the results should be cautiously generalized. Another was the small sample size in some included studies, meaning that statistical power decreased, inconsistency increased, and the magnitude of intervention effects decreased. Nonetheless, some studies with appropriate sample sizes found no significant association between self-confidence and intervention. It should be noted that the results may be influenced by the demographic profiles of the participants and the heterogeneity of the groups.

#### 4.2. Implications

In clinical nursing practice and education, self-confidence is an essential factor. Besides helping students complete their tasks accurately, it enables better communication with patients. Nurse educators can support students in the promotion of self-confidence by understanding effective teaching-learning strategies and their role in developing self-confident nursing practice. By applying these strategies, nurse educators can enhance the training and preparation of future professional nurses, allowing students to learn based on their motivations and gain self-confidence.

### 5. Conclusion

Nursing decision-makers and professors can use appropriate methods to increase the nursing students' confidence based on the needs and potential of their resources and human resources. Based on the findings, the most effective interventional strategies were education and simulation-based learning skills. However, it should be acknowledged that the outcomes of intervention programs to boost self-confidence require a long time, and further studies are needed to track the persistence of change. The complexity of nursing students' self-confidence suggests that interventions should be multidimensional and combined. Nevertheless, the comprehensive implementation of such interventions may come at a high cost, and it is necessary to provide the required executive conditions, such as participant preparation and the commitment of key individuals, before the intervention. Therefore, concerns such as spatial, temporal, and feasibility constraints should also be considered when applying these interventions.

#### CRediT authorship contribution statement

**Elahe Ramezanzade Tabriz:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Data curation, Conceptualization. **Masoumeh Sadeghi:** Writing – review & editing, Methodology, Formal analysis. **Ensieh Tavana:** Software, Formal analysis. **Hamid Heidarian Miri:** Writing – review & editing, Formal analysis, Conceptualization. **Fatemeh Heshmati Nabavi:** Writing – review & editing, Methodology, Investigation, Formal analysis, Conceptualization.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e27347>.



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