



A systematic review of the effectiveness of flipped classroom approaches in developing clinical skills among nursing students

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Abstract

Background: Acquiring clinical skills is vital in nursing education as it directly impacts students' competency and preparedness to provide safe and effective patient care. Flipped classroom approaches have gained attention, restructuring the teaching model to promote active learning and student engagement.

The effectiveness of flipped classroom approaches in developing clinical skills among nursing students was evaluated through a systematic review.

Methods: A systematic review methodology was employed to identify relevant studies. From the period 2013 to 2023, seven databases, namely ScienceDirect, Scopus, ProQuest, EBSCOhost, Sage Journal, Taylor and Francis, and PubMed, were searched through search strategy and the use of Boolean operators. Articles were assessed based on criterion and appraised using standardized tools: Joanna Briggs Institute (JBI) for quasi-experimental research & ROBVIS RCT checklist for assessing the risk of bias in randomized controlled trials. The authors employed the synthesis without meta-analysis (SWiM) guidelines for data analysis PRISMA checklist in finally appraising articles included for review.

Results: Eight articles (quasi-experimental and RCTs) out of 17,374 reviewed were conducted in Egypt, the United States, Turkey, Spain, and Taiwan. The studies involved 733 nursing students, and the duration of the interventions ranged from 10 to 16 weeks. Studies showed an overall low risk of bias and flipped classrooms significantly improved nursing students' clinical skills. The specific clinical skills that were improved included cardiopulmonary resuscitation, urinary catheterization, and safe medication administration.

Conclusion: Flipped classroom approaches are a promising pedagogical method for enhancing the clinical skills of nursing students. However, more research is needed to confirm these findings and to identify the best practices for implementing flipped classroom approaches in nursing education.

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Highlights

What is current knowledge?

Flipped classroom approaches enhance nursing students' clinical skills, reflecting a shift towards active learning methods.

What is new here?

This systematic review confirms the effectiveness of flipped classroom approaches in improving specific nursing skills like CPR and medication administration.

Introduction

The acquisition of clinical skills was a crucial aspect of nursing education, as it directly impacted nursing students' competency and preparedness to provide safe and effective patient care (1, 2). Traditional lecture-based teaching methods have long been the cornerstone of nursing education, but educators have increasingly explored innovative approaches to enhance student learning outcomes (3, 4). One such approach that gained significant attention was the implementation of flipped classroom approaches (5-7).

Flipped classroom approaches involved restructuring the traditional teaching model by shifting content delivery outside the classroom, typically through pre-recorded lectures or online resources, while using face-to-face class time for interactive activities, discussions, and knowledge application (5, 8, 9). This approach aimed to promote active learning, critical thinking, and student engagement by allowing learners to acquire foundational knowledge before class and utilize in-class time for deeper understanding and practical application (2, 6, 10).

The integration of flipped classroom approaches in nursing education held considerable potential, particularly in the development of clinical skills (11, 12). By allowing nursing students to engage with theoretical knowledge before attending clinical sessions, they could arrive better prepared, maximizing the practical learning experience (11). Additionally, the interactive nature of flipped classrooms fostered collaboration, peer-to-peer learning, and the utilization of

clinical reasoning, all essential elements in developing proficiency in clinical skills (13, 14).

While several studies have investigated the impact of flipped classroom approaches in various educational contexts (15-17), the specific effectiveness of this pedagogical method in nursing education, particularly in developing clinical skills, requires further exploration. Therefore, this systematic review aimed to comprehensively examine the existing literature to evaluate the effectiveness of flipped classroom approaches in enhancing the acquisition and application of clinical skills among nursing students.

By synthesizing and analyzing the available evidence, this study sought to provide valuable insights for nursing educators, curriculum developers, and policymakers to inform evidence-based decisions regarding integrating flipped classroom approaches in nursing education. Understanding the impact of this innovative teaching method could ultimately contribute to enhancing nursing education practices, ensuring that nursing students are well-equipped with the necessary clinical skills to provide high-quality patient care.

Methods

Study Design

This study employed a systematic review as the research method. The researchers utilized the PICO (People/ Participants, Intervention, Comparison, and Outcomes) framework to formulate questions specific to the effectiveness of flipped classroom approaches in developing clinical skills among nursing students, which is presented in Table 1. The research question guiding this study was "How effective are flipped classroom approaches in developing clinical skills among nursing students?"

Table 1. Description of PICO

People/ Participants	Nursing students
Intervention	Flipped classroom approaches, including pre-recorded lectures or online resources for content delivery and interactive activities, discussions, and practical application of knowledge during face-to-face class time.
Comparison	Traditional lecture-based teaching methods
Outcomes	Development of clinical skills among nursing students

Search Methods

A comprehensive literature search was conducted across seven databases, namely ScienceDirect (181), Scopus (191), ProQuest (16,847), EBSCOhost (10), Sage Journal (11), Taylor and Francis (100), and PubMed (34), covering the period from 2013 to 2023 (N=17,374). The search strategy involved the use of Boolean operators (AND, OR) for combining keywords and phrases. Quotation marks ("") were employed for exact phrase searching, and parentheses () were used for grouping similar concepts. The keywords used were: ("flipped classroom" OR "flipped learning") AND (nursing students OR student nurses) AND ("clinical skills" OR "patient care" OR "clinical competency").

Inclusion and Exclusion Criteria

The inclusion criteria for article selection in this study were as follows: (1) studies involving nursing students as participants, (2) publication in accredited international journals, (3) publication year between 2013 and 2023, (4) articles employing experimental designs such as randomized controlled trials (RCTs), quasi-experimental, or true experimental designs, and (5) articles written in English. On the other hand, the exclusion criteria encompassed (1) reviews, conference proceedings, protocols, case reports, surveys, and theses/dissertations, and (2) articles with limited accessibility or unavailability for download.

Screening of Articles

The screening process was performed by four reviewers (HKP, NPM, JCL, and MSA) and encompassed multiple stages. Initially, relevant keywords were identified across the seven selected databases. Subsequently, the titles and abstracts were evaluated to determine their appropriateness based on the inclusion criteria. The availability of full texts was assessed, considering their alignment with the study's requirements. In cases of disagreement between the reviewers (HKP, NPM, JCL, and MSA), a third group of reviewers (RIH, MMS, IUM, SPM, RHK, and AMM) was involved in reconciling any discrepancies and ensuring the accuracy of the screening process. This reconciliation step aimed to promote consistency and accuracy in the decision-making process (18).

Data Extraction

Fifteen articles meeting the inclusion criteria were selected for data extraction. All reviewers employed a grid synthesis format to extract relevant information, including authors, publication year, country, objectives, study design, hospital setting, intervention model, duration, results, and components of flipped classroom approaches relevant to the development of clinical skills among nursing students. The extracted data from each article were compiled and summarized in a table for further analysis (Table 2).

Quality Assessment of Selected Articles

To assess the quality of the included studies, the researchers employed critical appraisal tools developed by the Joanna Briggs Institute (JBI) for quasi-experimental research and the Critical Appraisal Skills Programme (CASP) for randomized controlled trials (RCTs). The JBI critical appraisal checklist for quasi-experimental research was accessed through <https://jbi.global/critical-appraisal-tools>. These JBI tools have undergone rigorous peer assessment and are endorsed by the JBI Scientific Committee (19). The quality assessment of RCTs was performed using the items of Risk-Of-Bias Visualization (ROBVIS) checklist available at <https://www.riskofbias.info/welcome/robvis-visualization-tool> (Table 3). The ROBVIS RCT checklist is a comprehensive tool for assessing the risk of bias in randomized controlled trials, ensuring rigorous evaluation of study design, conduct, and reporting (20). The critical appraisal process was conducted by HKP, NPM, JCL, and MSA, and in cases of disagreement, RIH, MMS, IUM, SPM, RHK, and AMM provided guidance based on the guidelines from JBI and ROBVIS.

Risk of Bias

For quasi-experimental designs, the risk of bias in individual studies was assessed using a cutoff approach. Studies were categorized as having a low risk of bias if they scored "yes" for 70% or more of the appraisal questions, a moderate risk if they scored "yes" for 50 to 69% of the questions, and a high risk if the "yes" scores were below 50% (21). Among the five articles reviewed, four were classified as having a low risk of bias and one was deemed to have a moderate risk (Table 4). Regarding RCTs, the risk of bias assessment was conducted using the Cochrane collaboration tool (22). Among the three articles focusing on RCT designs, one study had an unclear overall bias, two studies lacked clear blinding information, and one had uncleaned outcome data and selective reporting (Table 3).

Data Analysis

The authors employed the synthesis without meta-analysis (SWiM) guidelines for data analysis (23). The SWiM guidelines were utilized to synthesize quantitative data regarding intervention effects and were presented through nine reporting items. The first item involved categorizing studies into relevant sections, such as authors and publication year, country, objectives, study design, setting, intervention model, duration, results, and components of flipped classroom approaches relevant to the development of clinical skills. Items 1 to 3 involved reviewing the full-text articles that met the inclusion criteria to address the review questions. The analysis of the articles encompassed aspects such as study design, intervention methods, assessment tools, and intervention effects. The findings were summarized in a table (Table 2), allowing for comparison of similarities and differences among the outcomes reported in the included studies.

Table 2. Data extraction of the selected studies

No	Authors, year of publication, and country	Design	Setting	Intervention model	Duration	Results	Components of FC in the clinical skills development
1	Hassan EA, Elsaman SEA (2023), Egypt	Randomized controlled trial	University	Simulation-based flipped classroom	12 weeks	Significant improvement in CPR skills in the intervention group	Pre-recorded lectures, online quizzes, in-person skills practice
2	Kaplan A, Özdemir C, Kaplan Ö (2023), Turkey	Randomized controlled trial	Hospital	Flipped classroom	12 weeks	Significant improvement in clinical practice skills in the intervention group	Pre-recorded lectures, online quizzes, in-person skills practice
3	Elzaky, M.E.H., Elhabashy, H.M.M., Ali, W.G.M. et al. (2022), Egypt	Randomized controlled trial	University	Gamified flipped classroom	12 weeks	Significant improvement in skills competency and learning motivation in the intervention group	Pre-recorded lectures, online quizzes, gamified activities, in-person skills practice
4	Aguilera-Manrique et al. (2022), Spain	Quasi-experimental study	University	Flipped classroom	12 weeks	Significant improvement in urinary catheterization competency and self-efficacy in the intervention group	Pre-recorded lectures, online quizzes, in-person skills practice
5	Fan et al. (2020), Taiwan	Quasi-experimental study	University	Flipped classroom	12 weeks	Significant improvement in learning outcomes in the intervention group	Pre-recorded lectures, online quizzes, in-person skills practice
6	Wilson and Hobbs (2023), United States	Quasi-experimental study	University	Flipped classroom approach	16 weeks	Significant improvement in clinical skills performance in the intervention group	Pre-recorded lectures, online quizzes, in-person skills practice, feedback from peers and instructors
7	Jones, M. S., & Westfall, J. A. (2017), United States	Quasi-experimental study	University	Flipped classroom approach	10 weeks	Students in the flipped classroom group had significantly higher scores on a clinical skills assessment than students in the traditional classroom group.	Pre-recorded lectures, online quizzes, in-person skills practice
8	Zidan, S., Elsayed Rushdan, E., & AbdelRhman Khamis, E. (2020), Egypt	Quasi-experimental study	University	Flipped classroom approach	Not specified	Students who learned safe medication administration by flipped learning approach were higher than students who learned by the standard learning method.	Preparing instructional and teaching materials related to safe medication administration. Training sessions for clinical instructors on flipped classrooms and problem-solving skills. Faculty training sessions on the learning management system (LMS) for content and teaching material consistency. Practical sessions with the study group conducted by clinical instructors.

Table 3. ROBVIS risk of bias tool for RCT

Author (s) & year	Sample size (n)	Allocation concealment	Blinding	Incomplete outcome data	Selective reporting	Other bias	Overall
(Eman Arafa Hassan & Suad Elsayed Abdelmotalb Elsaman, 2023)	60	+	+	+	+	?	+
(Kaplan et al., 2023)	42	+	?	?	?	?	?
(Elzezy et al., 2022)	128	+	?	+	+	?	+

Note: (+) indicates a low risk of bias, (-) indicates a high risk of bias, (?) shows unclear risk of bias

Table 4. Risk of bias assessment for quasi experiment design

Author & year [sample respondents']	JBI assessment tools										Interpretationb	
	Q1a	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	% Yes		
(Aguilera-Manrique et al., 2022) [n=139]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
(Fan et al., 2020) [n=485]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
(Wilson & Hobbs, 2023) [n=218]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
(Jones & Westfall, 2017) [n=100]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
(Zidan et al., 2020) [n=183]	Yes	Notc	Not	Yes	Yes	Not	Not	Yes	Not	Not	56%	Moderate risk of bias

Notes:
^a Q1 – Q9 indicate questions 1 to 9 based on the JBI risk assessment
^b The risk of bias was ranked as high when the study reached up to 49% of “yes” scores, moderate when the study reached from 50 to 69% of “yes” scores, and low when the study reached more than 70% of “yes” scores
^c Not means “Unclear”

Results

Characteristics of the selected studies

There were eight articles that finally included in the review process. The researchers identified 17,374 articles from seven databases, and 16,721 articles were excluded according to limiters (year of publication, type of article, subject area, and open access). Thirty-eight articles were selected for review after the remaining 653 papers were filtered based on their titles and abstracts. A total of 615 articles were removed as they did not meet the inclusion criteria. Moreover, articles were assessed based on full text and eligibility. Finally, eight articles were included in this review after assessing their full eligibility and adding articles from the reference list (Figure 1).

Three reviewed articles came from Egypt, two from the United States, and one from Turkey, Spain, and Taiwan. Seven of the articles in this study were conducted at a university, and one in a hospital setting. There were six studies implemented flipped classroom approach, one simulation-based flipped classroom, and one gamified flipped classroom (Table 2). The duration of the intervention for five studies was 12 weeks, one with ten weeks and the other 16 weeks. Only one study has no specific duration of intervention. Moreover, the studies reviewed presented a significant improvement in the clinical practice skills of the intervention group with flipped classroom approach through pre-recorded lectures, online quizzes, and in-person skills practice.

Participants and study setting

The participants in this study were undergraduate nursing students enrolled in a nursing degree program. The majority (6 of 8 articles) of published studies are senior nursing students, both having clinical practice in the skills laboratory in a university and clinical exposure as part of the practicum. The participants of the two-studies year levels were not specific but clarified having a regular clinical schedule in the university clinical setting to develop their clinical skills. The highest number of participants in the quasi-experimental studies was 485 (15) nursing students 100 as the lowest (24). The number of participants in the RCT studies (see Table 3) was lower than quasi-experimental studies (Table 4).

Characteristics of the intervention and components of the FC in the clinical skills

The implementation of the treatment consists of a flipped classroom approach and several innovative combinations along with gamified and simulation-based (25, 26). The duration of intervention in most of the studies were 12 weeks (15, 25-28) with 16 weeks as the longest (29) and ten weeks as the shortest (24). However, there was one study that had no specific duration of intervention mentioned (30). FC components of the intervention included pre-recorded lectures, online quizzes, and in-person skills practice. Preparing instructional and teaching materials was related to safe medication administration. Moreover, training sessions for clinical instructors on flipped classrooms and problem-solving skills, as well as training sessions on the learning management system (LMS) for content and teaching material consistency, and practical sessions with the study group conducted by clinical instructors were some components of FC in the clinical skills development (26).

Clinical skills development with the flipped classroom

The results of all of the studies demonstrated a significant improvement in the clinical practice skills of the intervention group (e.g., CPR, urinary catheterization & safe medication administration) (26, 28, 30). The skills competency or performance of nursing students in the intervention group improved with the intervention of flipped classroom that scored higher compared to traditional classroom group (15, 25-29). Moreover, another study shows that the post-knowledge and practices scores of students who learned safe medication administration using the flipped learning approach were higher than those who learned using the standard learning method. There were significant statistical differences between the two groups (30).

Discussion

The selected review comprised eight articles investigating the impact of flipped classroom approaches on clinical skills development among undergraduate nursing students. Initially, 17,374 articles were identified across databases, with 16,721 excluded based on various criteria. Ultimately, 38 articles underwent full-text assessment, resulting in eight articles being included in the review. The studies were conducted across various countries, with Egypt, the United States, Turkey, Spain, and Taiwan being represented. Most studies (6 out of 8) involved senior nursing students engaged in clinical practice within university skills laboratories and real-world clinical settings. The flipped classroom interventions varied, with six studies utilizing a traditional flipped classroom approach, one using a simulation-based approach, and another employing a gamified approach.

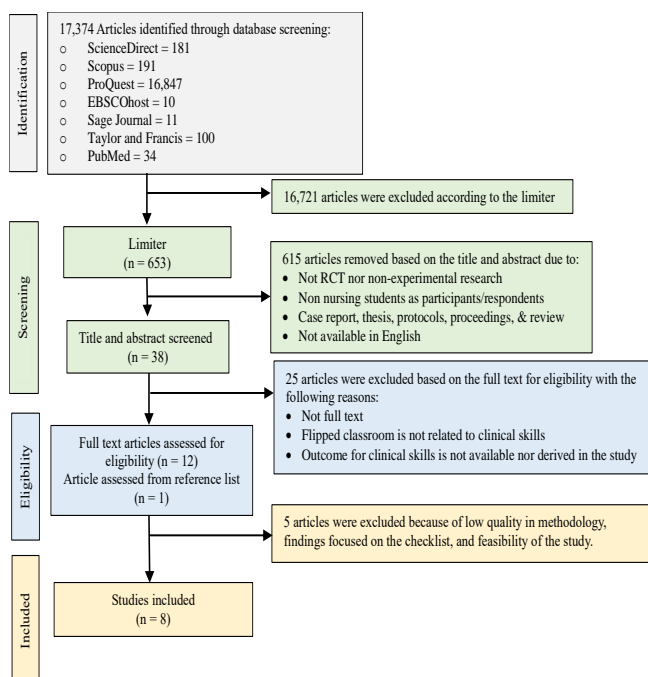


Figure 1. PRISMA flowchart

The intervention duration ranged from 10 to 16 weeks. Components of the flipped classroom interventions included pre-recorded lectures, online quizzes, and in-person skills practice. Notably, all studies demonstrated significant improvements in clinical practice skills among the intervention group, including CPR, urinary catheterization, and safe medication administration, compared to the traditional classroom methods. One study specifically highlighted higher post-knowledge and practice scores for safe medication administration in the flipped learning group compared to the standard learning group.

The findings of this systematic review are consistent with previous research on flipped classroom approaches in healthcare education (6, 27). Flipped classroom models have been shown to enhance student engagement, knowledge acquisition, critical thinking skills, and overall academic performance in various healthcare disciplines. This is in line with the findings of a meta-analysis, which demonstrated a significant effect in favor of flipped classrooms over traditional classrooms for health professions education, indicating that the flipped classroom approach has a positive impact on student learning in healthcare education (12). The learner-centered approach of the flipped classroom aligns with the needs of adult learners and promotes active learning strategies, which are essential in healthcare education. This is supported by research which emphasized the increase in demands for educational environments that have led to the evolution of various teaching models and learning strategies, such as the flipped classroom approach, in healthcare education (31). One of the key findings from the review was the significant improvement in the clinical practice skills of nursing students through the implementation of flipped classroom approaches, utilizing methods such as pre-recorded lectures, online quizzes, and in-person skills practice. It is consistent with a study which the effectiveness and acceptability of using the flipped classroom model during the COVID-19 pandemic in higher pharmaceutical education demonstrated relevance and applicability in healthcare education (32). This suggests that the integration of flipped classroom strategies can enhance the learning experience and contribute to the acquisition of essential clinical skills (11, 30, 33).

Despite the positive outcomes observed in the reviewed studies, it is essential to acknowledge that the implementation of flipped classroom approaches requires careful planning and consideration of contextual factors. Adequate technological infrastructure, access to resources, and faculty training are necessary to ensure the successful integration of flipped classroom strategies (34, 35). It is important to note that the quality assessment of the included studies indicated a low risk of bias for most of the studies (15, 24, 25, 28, 29). However, one study was classified as having a moderate risk of bias, and there were some unclear elements regarding blinding and outcome data in the assessed randomized controlled trials (30). These factors should be considered when interpreting the results and generalizing the findings. Further research is needed to explore the long-term effects of flipped classroom approaches on clinical skill development, as well as to compare the effectiveness of different flipped classroom models in nursing education.

Implications and Limitations

The findings underscore the significance of incorporating flipped classroom approaches in clinical nursing practice. The findings of this review provide robust evidence supporting the use of flipped classroom approaches in nursing education, demonstrating its effectiveness in fostering critical thinking, clinical reasoning, and overall competence in delivering patient care. By engaging students in active learning and promoting a learner-centered approach, flipped classroom models empower nursing students to acquire and apply clinical skills effectively. Incorporating these approaches into nursing curricula can contribute to better preparedness of future nurses, ultimately leading to improved patient outcomes and the delivery of high-quality care.

One limitation of the study is the restricted search to articles published in English and accredited international journals, which may have resulted in the exclusion of relevant studies published in other languages or regional journals. This limitation could introduce potential publication bias and restrict the generalizability of the findings. Additionally, the study focused on the period from 2013 to 2023, and although this timeframe allowed for a comprehensive analysis of recent literature, it may have excluded earlier studies that could have contributed valuable insights. Expanding the search to include a wider range of languages and publication sources, as well as considering studies published prior to 2013, could provide a more comprehensive understanding of the effectiveness of flipped classroom approaches in developing clinical skills among nursing students.

Conclusion

A systematic review of 8 studies (quasi-experimental and RCTs) found that flipped classroom approaches are effective in improving clinical skills development among undergraduate nursing students. The studies used a variety of flipped classroom interventions, including pre-recorded lectures, online quizzes, and in-person skills practice. Flipped classroom can be effectively applied to clinical skills development in nursing students by providing them with pre-recorded lectures and other learning materials to watch outside of class, which frees up class time for active learning activities such as practice exercises, case studies, and peer-to-peer tutoring. The effectiveness of flipped classroom

approaches in developing clinical skills among nursing students hold practical implications for nursing education as it fosters active engagement, critical thinking, and individualized learning. This approach can be extended in the actual clinical set-up for nursing students in performing various clinical skills set as part of their on-the-job training to maximize opportunities in providing healthcare service to clients. These practical applications underscore the potential of flipped classrooms to reshape nursing education, ultimately producing better-prepared and clinically adept nursing professionals. For a successful implementation of flipped classrooms, it is recommended to have careful planning, adequate technological infrastructure, resource access, and faculty training. The study also emphasizes the need for further research to explore the long-term effects of flipped classroom approaches on clinical skill development and to compare the effectiveness of different flipped classroom models in nursing education.

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Ethical statement

Not applicable

Conflicts of interest

The authors declare no conflict of interest.

Author contributions

HKP oversaw the entire research project, including conceptualization and study design. HKP, NPM and RIK conducted the literature review. HKP, JHCL and MSB performed data analysis and interpretation. RIH, MMS, and IUM drafted the manuscript under HKP's guidance. HKP, SPM, RHK and AMM provided critical review and feedback on the manuscript. All authors contributed to the final approval of the manuscript for submission.

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