Research Article

Computer Assisted Instruction Versus Conventional Didactic Lecture Methods on Clinical Competence of Nursing Students- a Brief Meta-Analysis

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ABSTRACT

Optimum clinical competence in knowledge and skills are the desired learning outcomes in nursing education. Nurse educators seek effective alternative methods of instruction in situations of physical and social distancing where the face-to-face (F2F) lecture method is not feasible. This study aims to determine whether computer-assisted instruction (CAI) compared to the conventional F2F lecture method, is more effective at improving nursing students' clinical competence. This meta-analytic study followed the Preferred Reporting Items for Systematic Reviews and Meta-analysis guidelines. An electronic search for literature was conducted in PubMed, EBSCO essentials, and Google Scholar databases from February to October 2022. Members of the research team separately gathered data from all relevant studies and evaluated the strength of the evidence. Out of 62 articles, only six met the eligibility criteria and were included in the meta-analysis after duplicate articles were removed. Results showed that CAI and F2F lecture methods were compared in all the included articles. Overall, the meta-analysis found no significant difference in competence outcomes between those who received CAI or F2F lectures (Mann-Whitney U = 18, p = 0.396). In conclusion, CAI is just as effective as F2F at enhancing nursing students' competence. CAI or F2F lecture methods can be used by nurse educators to improve clinical competence outcomes in nursing students.

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INTRODUCTION

Nursing is a health care discipline in which critical thinking and psychomotor skills are essential for clinical problem-solving. (Clerkin, et al. 2022). It applies the conventional face-to-face (F2F) didactic lectures and physical demonstrations to nursing knowledge and skills education (Horton-Deutsch, et al. 2012). Given that nursing students must acquire the most optimal variety of cognitive and psychomotor skills, the conventional didactic F2F lecture does not always meet the expected learning needs (Hu, et al. 2012). Moreover, circumstances such as the brain drain and turn-over rate of nursing educators within the nursing education system in low-resource countries have reduced the available nurse educators and decreased opportunities for quality nursing education (Likupe, 2013).

Consequently, Computer Assisted Instruction (CAI) methods are continually tested by nurse educators for effectiveness to either supplement or complement the didactic F2F lecture method in line with presenting situations (Chang,et al.2022).

The use of computers in nursing education since the COVID-19 lockdown has increased (Bourgault, et al. 2022). CAI grew in use for its capacity to increase participation in the teaching process and facilitate student-centered learning and self-direction (Hwang, et al. 2022). CAI is also considered flexible and reduces instructional costs and demands on resources (Gause,et al. 2022a). Its ability to improve students' computer proficiency adds to its benefits for use in nursing education((Gause,et al 2022b). CAI involves facilitating and supporting

educational instructions through computers and information technology (Williams, et al.2018). In the literature, CAI involves a broad spectrum of technologically enhanced teaching strategies, which may cause confusion and ambiguity (Brusamento,et al. 2019). In this study, CAI was used to refer specifically to an educational module delivered to students in a digital or Computer-based format.

Given that the use of CAI in nursing education has increased, it is crucial to assess its effectiveness against the conventional F2F lecture method (Fung, et al. 2021). Although previous primary studies have demonstrated that CAI enhances the knowledge and skills of nursing students, majority of the studies utilized the one-group prospective design (Zheng, et al .2121). Therefore, it is inconclusive whether CAI is better than the F2F lecture method or vice versa (Brusamento,et al. 2019). This study will examine the evidence concerning the effectiveness of the CAI compared to the F2F lecture method in enhancing the clinical competence of nursing students.

The PICO framework guided the evidence-based clinical practice question for this study. PICO is an acronym for Population, Intervention, Comparison, and Outcome. The evidence-based clinical practice question was as follows: Among nursing students, is there evidence to suggest that computer-assisted instruction compared to didactic face-to-face lecture results in better improvement in clinical competence (knowledge and skill)?

MATERIALS AND METHODS

A brief meta-analysis of the available evidence concerning the effectiveness of CAI and the F2F lecture method in improving the clinical competence of nursing students was done. The systematic search adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines illustrated in Figure 1. Nonetheless, this study was not registered with the International Prospective Register of Systematic Reviews (PROSPERO) as it is a student project. Articles in the literature were searched in PubMed, EBSCO essentials, and Google Scholar electronic bibliographic research databases from February to October 2022.

The inclusion criteria were: free full-texts of primary study articles (experiments and quasi-experiments), a follow-up duration of not less than one hour, articles published in the English language between 2008 and 2022 (15 years), and a study population consisting of nursing students only. The exclusion criteria were: blended instruction method, studies that did not report mean and standard deviation values, qualitative studies, non-experimental studies, grey literature, and studies involving respondents younger than 18 years old. The search strategy was: ("Computer Assisted Instructions") AND (Lecture OR "Face to face" Teaching) AND ("Nursing students"). A total of 62 articles were retrieved (PubMed = 0, EBSCO essentials = 7, and Google Scholar = 55).

The retrieved 62 articles were independently screened by members of the research team for duplicates and six articles were removed. The remaining 56 articles were screened by title and 38 articles with non-relevant titles were removed. The remaining 11 articles were screened by abstract, 1 article involving pharmacy students was removed and 4 articles involving blended instructions were also removed. The full text of the remaining 6 articles was screened for eligibility and any disagreements between the assessors were resolved by consensus before the final selection of each of the included articles. Using a spreadsheet, the following information was retrieved from the included full-text articles: authors, date, country, aim, design, sample, instrument, and results (Table 1).

Quality of included studies and risk of bias assessment

The included studies were assessed for quality of nursing evidence using the Johns Hopkins Nursing Evidence Appraisal Tool. Three of the included articles had Level I nursing evidence (Experiments) while the remaining three articles had Level II nursing evidence. The Medical Education Research Study Quality Instrument (MERSQI) is a free, standardized, and validated quality assessment tool used to evaluate the quality of experimental, quasi-experimental, and observational studies in medical and health professions education. (Cook, et al. 2015). The MERSQI was used to assess the methodological quality of the included articles and all the included studies score above 11.5 cut-off mark. In line with the PRISMA recommendations, the research team members independently evaluated each of the included research articles for quality. Risk of reporting bias was not assessed.

Data analysis

The mean difference between reported post-test scores of CAI and F2F lecture in the articles was used as an objective measure of the teaching method effectiveness. To calculate the mean difference points and make a forest plot, the extracted data were entered into Microsoft Excel 2007 (Microsoft Corp., Redmond, USA). The computed mean difference data were used to populate a descriptive evidence synthesis table to demonstrate the comparative effect across the included articles. The consistency in results was determined by visualizing the direction of the effect in the evidence synthesis table and forest plot. The Mann –Whitney U test was used to test the difference in direction of the effect between the CAI and F2F at a 5% level of significance with the help of SPSS 21 (Statistical Products and Service Solutions, IBM Corp., Armonk, USA).

RESULTS

A total of 62 articles were screened and 6 articles from six countries were included in this study as outlined in the PRISMA flow diagram (Figure 1). The six articles were from England (n = 1), Spain (n = 1), South Korea (n = 1), Australia (n = 1), Turkey (n = 1), and China (n = 1).

The included articles involved a total of 770 participants (348 participants in the CAI group and 422 in the F2F group). The characteristics of the included articles were outlined in Table 1. All the articles compared CAI to F2F instruction methods. Half (50%) of the articles utilized the experimental design. To assess competence, Half (50%) of the articles examined the knowledge domain (Hand washing, general medical-surgical, and subcutaneous injection) and the other half (50%) assessed the skills domain (Urinary catheterization and general clinical skills). The Knowledge domain was assessed using a questionnaire (Quiz) while the skills domain was assessed with

the Objective Structured Clinical Examination (OSCE) in the articles.

Table 2 presented the mean difference between CAI and F2F in the included articles. The mean difference in the articles ranged from -1.9 to 3.2. None of the included articles revealed a significant mean difference between CAI and F2F (p = >0.05). Figure 2 outlined a forest plot of the mean differences. About 33.0% of the studies favored the CAI and another 33.3% favored the F2F instruction method. The cumulative mean difference between CAI and F2F was statistically equivalent (Mann-Whitney U = 18, p = 0.936).

DISCUSSION

This study sought to determine whether CAI is more effective than the F2F lecture method in improving competence among nursing students. All the studies included in this study compared CAI to the F2F teaching method. Results of this study show insufficient evidence to suggest any significant difference in effectiveness between CAI and F2F lecture methods. Although the self-directed CAI may seem attractive to academic nurse educators who run a busy schedule between teaching, mentorship, and research, this study found insufficient evidence to recommend CAI over F2F.

The finding of this study corroborates the results of a recent meta-analysis published in medical literature, which demonstrated that CAI was equivalent to the F2F lecture method in improving ECG competence (Viljoen,et al. 2019). The findings also support the findings of a Randomized Controlled Trial conducted in the United Kingdom that concluded that CAI is as effective as the F2F lecture method (Davis, et al, 2007).The rationale for the finding in this study is that although images are widely used to demonstrate concepts in nursing education, some scholars suggest that good explanations are also very important (Nilsson,et al. 2008). Just as note-taking in F2F can enable students to achieve self-assessment repetitions, there are also opportunities for repetitive practice and self-reflection in CAI as some students can repeat self-assessments and correct their errors to improve their competence (knowledge and skills). (Mondal, et al, 2020).Given that CAI does not require class attendance, some students may require reminders to motivate them to actively use CAI modules. (David, et al 2020).

In recent times, nursing education has long laid value on the use of images and self-paced/self-directed learning to embed knowledge into the learner's short and long-term memory (Mitchell, et al 2014). However, the finding of this study was unexpected owing to the elaborate theoretical advantages of CAI over the F2F lecture. Where F2F lecture is time-limited, CAI serves as a good example of self-directed learning whereby students plan and conduct their learning (Devi, et al 2019). Where F2F lecture is ideal for promoting collaborative learning by allowing interaction between peers and educators, CAI allows for flexibility in learning as students can adjust the pace of their learning and spend as much time as they need to assimilate new knowledge (Ali, et al 2019). Furthermore, CAI learning opportunities have the advantage of offering multimedia learning resources, which enrich the educational content through animation, audio, and video (Soleimanpour, et al, 2017).

Limitations

The fact that this study included recently released publications is one of its strengths. Furthermore, data from different countries were used to balance out any outliers. All the included articles were conducted in wealthier nations outside of Africa, therefore, findings from this study cannot be generalized to African nations with limited resources.

CONCLUSION

The findings of this study suggest that there is insufficient evidence to conclude that CAI is more effective than the F2F lecture method for improving clinical nursing competence. To help nursing students develop the appropriate levels of competence, nurse educators can use the CAI or F2F lecture methods, as they are equally effective.

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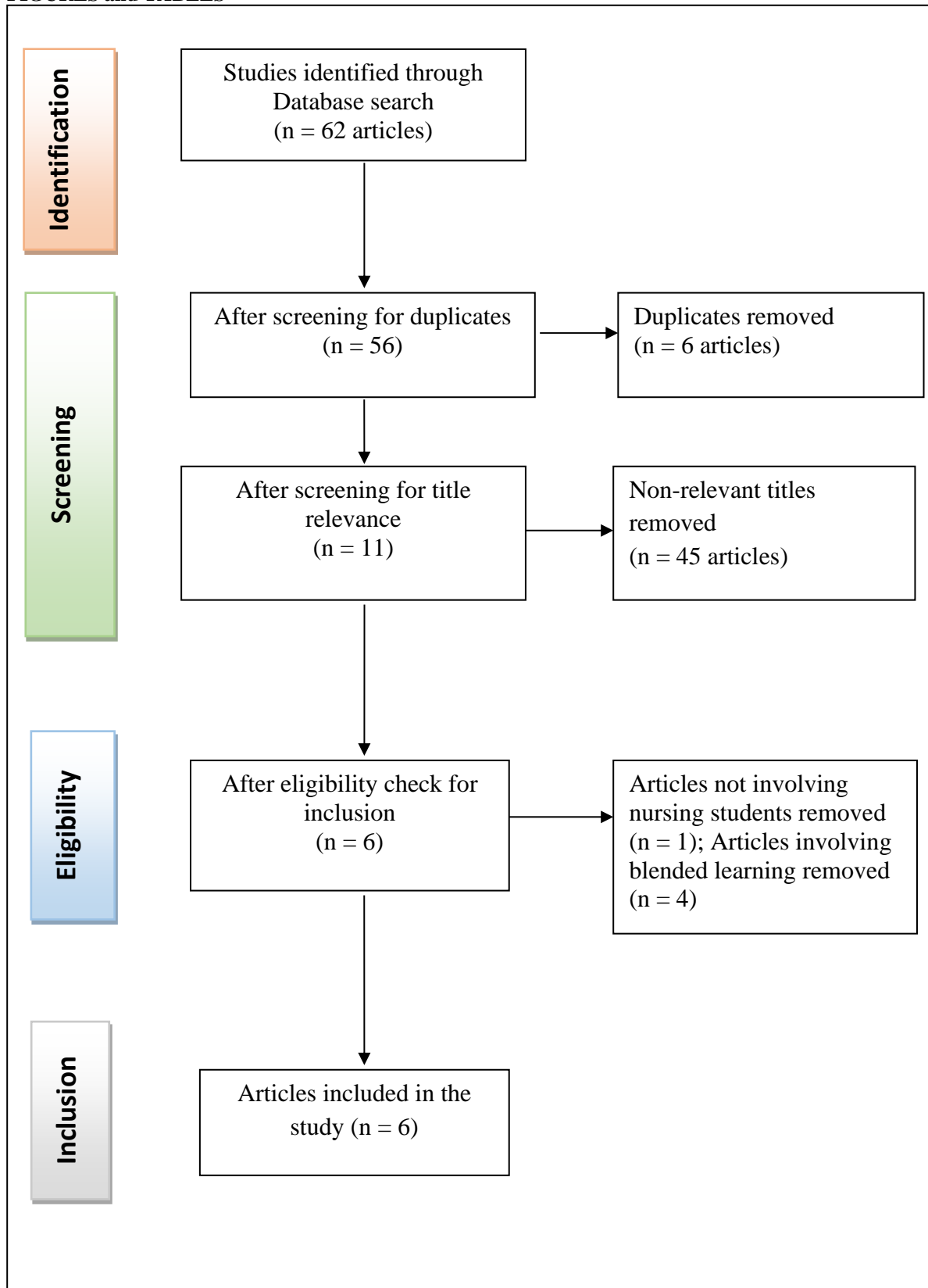
FIGURES and TABLES

Figure 1: A PRISMA flow diagram of article search and selection process

Table 1: Characteristics of the included articles

Author, date, country	Aim	Design	Sample	instrument	Results
Bloomfield et al. (2010), England	The study compared conventional face-to-face instruction with computer-assisted instruction to see if nursing students could learn and remember the theory and skill of hand-washing more effectively.	Randomized Controlled Experiment	Randomized sample of first year students CAI = 118 F2F = 113	Knowledge of hand-washing Quiz	Post test CAI = 14.0(1.7) F2F = 14.0(1.9) p = 0.578
Fernández-Alemán, et al. (2011), Spain	To compare CAI and face to face lecture method on retention of medical-surgical nursing knowledge.	Randomized Controlled Experiment	Randomized sample of second year students CAI = 54 F2F = 62	Medical-Surgical nursing knowledge Quiz	Post test CAI = 6.5(0.6) F2F = 6.5(0.9) p = 0.330
Lee, et al. (2016), South Korea	To compare CAI and face to face lecture method on retention of clinical nursing skill.	Randomized Controlled Experiment	randomized sample of second year nursing students CAI = 36 F2F = 35	Urinary catheterization skills OSCE (Objective Structures Clinical Examination)	Posttest CAI = 27.2(2.5) F2F = 26.5(2.2) P = 0.236
Terry, et al. (2018), Australia	To compare CAI and face to face lecture method on retention of clinical nursing skill.	Quasi-experiment with control	Convenience sample of first year students CAI = 34 F2F = 38	OSCE	Posttest CAI = 68.7(5.9) F2F = 65.5(11.5) P = > 0.05
Vicdan (2018), Turkey	To assess the performance of undergraduate nursing students after teaching subcutaneous injection using two distinct approaches.	Quasi-experiment with control group	Simple random sample of first years nursing students CAI = 41 F2F = 44	Knowledge and application of Subcutaneous injection Quiz (Preparation, administration, and termination domains)	Posttest CAI = 10.0(1.0) F2F = 11.9(0.7) p = <0.05
Yang, et al. (2019), China	To compare CAI and face to face lecture method on retention of clinical nursing skill.	Quasi-experiment with control	Quota sample of nursing students CAI = 65 F2F = 130	OSCE	Posttest CAI = 88.8(7.4) F2F = 89.6(3.2) p = 0.746

Table 2: Descriptive evidence synthesis

Author, date, country	CAI posttest mean score	F2Fposttest mean score	Mean difference	p
Bloom et al. (2010), England	14.0	14.0	0.0	0.578
Fernández-Alemán, et al. (2011), Spain	6.5	6.5	0.0	0.330
Lee, et al. (2016), South Korea	27.2	26.5	0.7	0.236
Terry, et al. (2018), Australia	68.7	65.5	3.2	>0.05
Vicdan (2018), Turkey	10.0	11.9	-1.9	> 0.05
Yang, et al. (2019), China	88.8	89.6	-0.8	0.746

CAI = Computer Assisted Instruction, F2F = face-to-face lecture, p = p value between groups, + mean difference favors CAI, - mean difference favors F2F

Figure 2: Forest plot of mean differences