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Comparison of education using the flipped class, gamification and gamification in the flipped learning environment on the performance of nursing students in a client health assessment: a randomized clinical trial

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Abstract

Background Since effective education is one of the main concerns of every society and, in nursing, can lead to the education of successful people, the development of learning and teaching methods with greater effectiveness is one of the educational priorities in every country. The present study aimed to compare the effect of education using the flipped class, gamification and gamification in the flipped learning environment on the performance of nursing students in a client health assessment.

Methods The present study was a Parallel randomized clinical trial study. The participants were 166 nursing students. The clinical trial data was collected from December 14, 2023, to February 20, 2024. The inclusion criteria were nursing students who had passed the first semester, who were willing to participate and install the app on their mobile devices, and who had no experience with the designed application for this study. The participants were allocated to four groups with colored carts. In the first group, teaching was performed via gamification in a flipped learning environment; in the second group, teaching was performed via the gamification method. A flipped class was implemented in the third group. In the fourth group, the usual lecture method was used. The practical performance to assess the physical health assessment with 10 questions using the key-feature questions, along with the satisfaction and self-efficacy of the students, was also checked with questionnaires.

Results In this study, 166 nursing students, (99 female and 67 male), with an average (standard deviation) age of 21.29 (1.45) years, participated. There was no statistically significant difference in the demographic characteristics of the participants in the four intervention groups ($P > 0.05$). Comparing the results before and after the intervention, the results of the paired t test indicated a significant difference in the satisfaction, learning and self-efficacy of the learners ($P < 0.001$). In the comparison of the four groups, the ANOVA results for the comparison of the average scores of knowledge evaluation and satisfaction after intervention among the four groups indicated a statistically

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significant difference ($P < 0.001$). When the knowledge evaluation scores of the groups were compared, the scores for gamification in the flipped learning environment were significantly different from the other methods ($P < 0.05$), and there was no significant difference between the scores for the flipped class and lecture methods ($P = 0.43$). According to the ANOVA results, when comparing the satisfaction scores of the groups, the students in the flipped learning environment and gamification groups were more satisfied than the flipped class and lecture groups ($P < 0.01$).

Conclusion Based on the results of the present research, it can be concluded that teaching methods have an effect on students' learning and satisfaction. The teaching method has an effect on the satisfaction of the students, and the use of the flipped class method with the use of gamification was associated with more attractiveness and satisfaction in addition to learning. Teachers can improve the effectiveness of education with their creativity, depending on situation, time, cost, and available resources, by using and integrating educational methods.

Keywords Flipped classroom, Gamification, flipped learning environment, Nursing, Student, Mobile application

Introduction

Effective education is one of the main concerns of every society [1]. Because the traditional methods of teaching, learning and management have little effectiveness [2], multiple learning strategies of active learning and the use of technologies [3–5], it is helpful to integrate the classroom approach among these methods. The reverse is the use of a playful method [6, 7]. The flipped classroom was presented in 2007 by Bergmann and Sams, two chemistry teachers at Woodland Park High School in Colorado (USA). Their goal was to ensure that students who could not attend class for various reasons could proceed at the pace of the course and not be harmed due to not attending class [8]. Bergmann and Sams videotaped and distributed instructional content and found that this model allowed the teacher to focus more attention on the individual learning needs of each student [5, 8].

In 2014, the Flipped Learning Network (FLN) was introduced, in which flipped learning was defined as "an educational approach in which direct instruction is transferred from the group learning dimension to individual learning, and in a dynamic and interactive learning environment, where the instructor guides students in applying concepts and engaging creatively with course content". The four pillars of flexible environment, learning culture, purposeful content and professional instructor have been described in opposite directions [9, 10]. In addition to the ever-increasing complexity of the healthcare environment and the rapid advancement of healthcare technology, a global pandemic (COVID-19) has affected educational structures. The pandemic has caused a global educational movement toward blended learning to meet students' technological and hands-on learning needs. Indeed, at no time in history has there been such a sudden transition to this type of learning [11], where the flipped classroom was widely used [9].

In nursing education, the use of flipped classrooms [9, 12] and technologies [3, 5] has been emphasized. The results obtained in the systematic review of the effect of the flipped classroom on academic performance in nursing education indicated its positive effect, and the opinions of most students about this method included aspects such as its usefulness, flexibility, greater independence or greater participation [13–19]. According to the cognitive bases related to the Bloom's taxonomy, with the flipped classroom method, the student works in the first stage of the learning process at home, which is the simplest stage, and in the second stage, through active learning with the help of the teacher and classmates, in class time, which is used to increase and empower more [20, 21]. In addition, the flipped classroom method has certain advantages over traditional learning. The flipped classroom is student-centered and makes students responsible for their own learning [22], and its use in nursing has been emphasized in systematic review studies [3, 23, 24].

One of the interactive teaching methods using computers is the gamification method. Gamification in education includes the use of game elements to increase motivation and participation and to involve students in the personal learning process [1, 25]. Gamification is an active education method. The gamification system increases the level of engagement and motivation of learners by provoking excitement and creating challenges for them. Additionally, with this method, it is possible to provide an opportunity for testing, and in that test, in addition to creating a challenge, learners are given the opportunity to display their achievements through competition [26].

Nursing education institutions are obliged to improve the ability of nursing students to make correct clinical judgments through various educational programs and the use of new teaching methods [27, 28] so that when nursing students enter the clinic, they can fulfill their role as members of the medical team [27]. Therefore, it is necessary to carry out more research regarding the identification of effective teaching methods that can improve the attractiveness of education and its satisfaction among nursing students [1, 27].

This study addresses the lack of comparative research on the effectiveness of flipped classrooms and

gamification in nursing education, an area that has not been sufficiently explored. The advantages of combining education methods are that they can be used together [6, 7]. For example, by combining education using the flipped class with gamification, more study time is provided by using the flipped class, and the attractiveness of the method is provided by gamification [7]. Therefore, considering the attractiveness of the new application that is prepared in a flipped class, the current research was conducted aimed at comparing the effects of education using the flipped class, gamification and gamification in the flipped learning environment on the performance of nursing students in terms of client health assessment.

Method

The present study was a parallel randomized clinical trial research aimed at comparing the effect of education using the flipped class, gamification and gamification in the flipped learning environment on the performance of nursing students in a client health assessment. The clinical trial data was collected from December 14th, 2023, until February 20th, 2024.

Participants

First, in a call, 247 nursing students registered to participate in the study. After checking the entry criteria, 188 people met the entry criteria for the study. The inclusion criteria were nursing students who had passed the first semester, who were willing to participate and install the app on their mobile devices, and who had no experience with the designed application for this study. Exclusion criteria were: miss the mobile and drop out of study, for example, because of transferring, migration or do not like to continue participating in the study. So, 18 students were excluded from study for unwillingness to continue, 2 students because of migration were excluded, and 2 people were excluded for missing their mobile (Fig. 1).

The participants were allocated to four groups with using colored carts. Before sampling, 188 carts in 4 blue, red, black and white colors (from each color, 45 carts) were prepared in one enveloped pocket. After completing the informed consent and pre-test questionnaires, each student took a colored card from the enveloped pocket. Then, with the lottery, it was determined that the participants with the blue card participated in the gamification in a flipped learning environment, the red cart in the gamification, the black cart in the flipped class, and the white cart in the lecture method. The study and sampling process is shown in Fig. 1.

Intervention

The education course was 4 class in 60 min of health status assessment in 4 weeks. Each group has a classroom weekly. Education content was health assessment and clinical examination courses of the Bachelor of Nursing

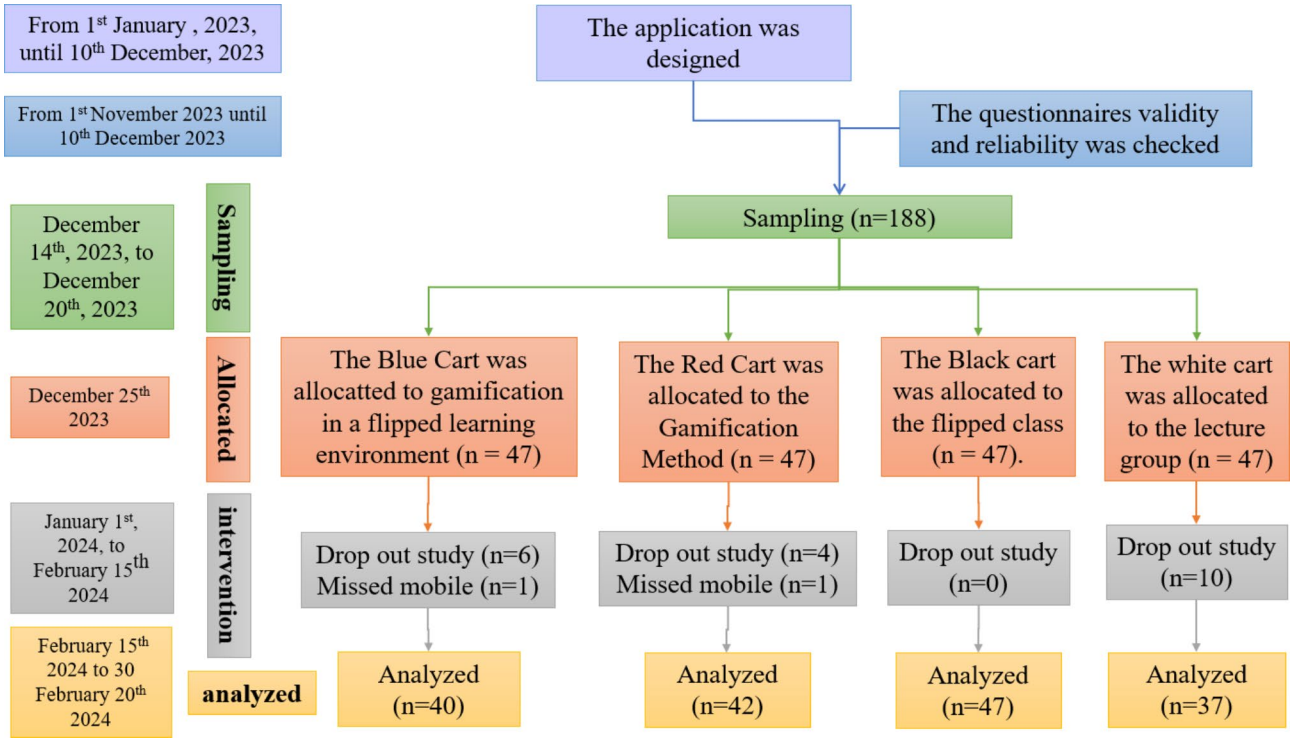

Fig. 1 Study and sampling process

Education curriculum. Course plan was developed based on the curriculum.

For intervention, the application was designed using the cascade model (initial analysis, system analysis, design, programming, testing (alpha and beta), implementation and modification) [29, 30]. In the initial analysis stage, the need or the desired problem, which is the issue of education improvement, is raised, and can technical solutions be provided for it? If there are possible solutions, the practicality is evaluated, and in the analysis of the visual appeal system, the up-to-date information, simple language, and comprehensiveness of the information provided in the educational content are checked. In the design phase, the design of the desired system was written, and a program was written by the programmers according to the initial design of the system.

The educational content of the application was prepared based on the health assessment and clinical examination courses of the Bachelor of Nursing Education Program, approved by an expert panel. The application was designed in two parts: education and scenario-based games. In the education section of the application, the content of the education was presented, and in the scenario base game section, the 10 scenarios of health status assessment and clinical examination were designed based on real situations.

In the scenario base game section of the application, the application was embedded as a game in such a way that the student, at the first, observes the chief compliance of the patient, and they must complete patient examinations and choose the correct answer. If they choose correctly, they will take a green cart, and if they make a mistake, they will take a red cart. They could take 4 green carts in each scenario. A yellow cart was shown when the answer was not incorrect, but it was not an exact answer. In each scenario, they must find the correct nursing diagnosis. They must provide a nursing diagnosis based on the priority of care in the scenario.

The fundamental elements of gamification are mechanics (motivating students through points, budgets and rewards), dynamics (engaging users through stories and narratives), and aesthetics (user experiences from applications about being user-friendly and attractive) [31–33]. The mechanics element was considered in the application, with green carts in each stage. The dynamic element was considered in the scenarios. The aesthetic element was considered and checked in alpha and beta tests.

In the test phase, the Application was checked for errors, and it was tested for user acceptance in two parts, the alpha and beta tests. In the alpha test, the program was used by the designers (four academic nurses and 4 IT men) as users, and in the beta test, a group of users (20 nursing studentsThe fundamental elements of a flipped class are that the students must read the content before the class and do the assignment in the class. In this study, this element was considered, and the provided content was given to participants at first. The students read content for each class before the class, and they solved the assignment in the class. The provided content for the flipped class group was designed in the PowerPoint files, and for the gamification in the Flipped Learning Environment group was designed in the application.

It was improved based on their opinions, and in the next stage, the approved application by the designer and user was used in this study.

Lecture group

In the Lecture group, the content of the education was held in the lecture method, and in each section, at the end of class, a scenario of the designed was given to the students as an assignment. They must solve it by next week. At the end of the study, four scenarios were performed by the students as assignments in this group.

Flipped class group

In the Flipped class group, the content was prepared in the four voiced PowerPoints and presented them to the students in the first session. Students read the content of each class, and in class they discussed the educational content and solved the scenarios as an assignment. Eight scenarios were discussed by the students as assignments in this group.

Gamification group

In the Gamification group, in each class, after the educational content was presented, the homework was presented, and students played a scenario of application in the class. Four scenarios were performed by the students as assignments in this group.

Gamification in the flipped learning environment group

In the Gamification in the Flipped Learning Environment group, the designed mobile application was presented in the first session of the course. Students must read the content of the session before the class, and in class they discussed the educational content and solved the scenarios as an assignment. Eight scenarios were performed as homework by students in a gamification environment.

Data collection tools

In this study, a questionnaire with 10 key-feature questions (KFQs) was designed by an expert panel of 10 academic nurses. After designing a KFQ questionnaire, its validity and reliability were examined. Validity was confirmed with a content validity ratio (CVR) of 14 expert (academic nurses) and qualitative validity with 7 academic and 7 clinical nurses; reliability was checked by test-retest. The CVR of the questionnaire was 0.96 and

Table 1 Demographic characteristics of the participants

		Group								Test Result
		Gamifcation in flip environment		Gamifcation		Flipped Class		Lecture		
		Count	*N* %	Count	*N* %	Count	*N* %	Count	*N* %	
Gender	**Male**	16	9.6%	20	12.0%	19	11.4%	12	7.2%	X^2
	Female	24	14.5%	22	13.3%	28	16.9%	25	15.1%	df = 3 *P* = 0.59
Semester	**3**	20	12.0%	27	16.3%	23	13.9%	16	9.6%	*P* = 0.27
	2	20	12.0%	15	9.0%	24	14.5%	21	12.7%	
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	***P* value**
Age		21.98	1.44	21.71	1.25	22.28	1.68	21.97	1.32	*P* = 0.25
Overall GPA		16.91	0.97	17.00	1.07	16.94	1.06	17.18	0.78	*P* = 0.32
Mark		17.34	0.84	17.09	0.77	16.86	1.47	17.35	0.93	*P* = 0.33
KFQ Examination Result before		12.78	1.17	12.67	1.07	13.09	0.88	13.05	0.97	*P* = 0.17
Self-efficacy before		19.08	2.53	19.17	2.48	19.38	2.38	19.48	2.35	*P* = 0.88
Satisfaction before		41.35	4.91	41.45	3.93	41.26	7.20	41.62	7.25	*P* = 0.96

was confirmed. All seven academic and seven clinical nurses confirmed the qualitative validity of the questionnaire. The content validity coefficient based on the number of participating professors (at least 10 people) is 0.49 as the minimum acceptable according to the Lauwshe Tables (18, 19) and the necessity of the items of tools was confirmed.

For the test-retest of KFQ questionnaire, 10 nursing students participated. They filled out the questionnaire twice, with an interval of two weeks. The correlation coefficient between their answers was 0.93 with Spearman's correlation coefficient. The correlation coefficient above 0.7 is good [34, 35].

Additionally, education satisfaction was investigated with the Measuring Student Satisfaction Scale from the Student Outcomes Survey [27], which includes 20 items. The validity of it was confirmed with CVR, and the reliability was checked by Cronbach's alpha. The CVR of the questionnaire was 0.91 and was confirmed. Cronbach's alpha was 0.69. Cronbach's alpha coefficient above 0.7 is good, 0.3–0.7 is good, and less than 0.3 is poor [34, 35]. The overall Cronbach's alpha was appropriate reliability.

The Sherer questionnaire tool was used to assess the self-efficacy of the nursing students [36]. This tool contains 17 items on a five-point Likert scale. Sherer et al., confirmed the reliability of the questionnaire with Cronbach's alpha 0.76 [36]. Also, for this questionnaire, the validity was confirmed with CVR, and the reliability was checked by Cronbach's alpha. The CVR of the questionnaire was 0.90 and was confirmed. Cronbach's alpha was 0.45.

Data analysis

The analysis of the research data was performed using the Statistical Package for Social Sciences version 20. The Kolmogorov-Smirnov test was used to assess the normality of the data. Data analysis was performed by using descriptive tests, such as percentage, mean and standard deviation, and statistical tests, such as the chi-square test, paired t test, and ANOVA. In all statistical tests, a significance level was considered less than 0.05.

Table 2 The results of comparing the satisfaction and self-efficacy of participants before and after the intervention

	Mean	*N*	SD	*P* value
KFQs Examination Result before	12.90	166	1.03	0.001
KFQs Examination Result after	17.98	166	1.25	
Satisfaction before	41.41	166	5.96	0.001
Satisfaction after	43.24	166	5.88	
Self-efficacy before	19.27	156	2.42	0.001
Self-efficacy after	27.32	156	1.63	

Results

In the present study, 166 nursing students, 99 women and 67 men, with an average (standard deviation) age of 21.29 (1.45) years, were participated. The demographic characteristics of the participants are shown in Table 1. The homogeneity of the intervention and control groups was checked with statistical methods, and the results are reported in Table 1. There was no statistically significant difference in the demographic characteristics of the participants in the groups ($P > 0.05$).

Comparing the results before and after the intervention, the results of the paired t test indicated a significant difference in the satisfaction, learning and self-efficacy of the learners ($P < 0.001$). Table 2 shows the results of paired t tests.

The ANOVA showed that a statistically significant difference between the mean scores of knowledge and satisfaction after intervention in the four groups ($P < 0.001$). The result of the ANOVA was not significant difference between the mean of the self-efficacy after intervention in the four groups ($P = 0.101$).

In the analysis of the groups, there was a significant difference in the comparison of the knowledge evaluation

scores, such that there was a significant difference between the average of the gamification methods in the flipped learning environment group and the gamification compared to the inverted class and lecture, considering equal variance ($P<0.001$). There were significant differences at the 0.05 level between the two gamification methods in the flipped learning environment group and the gamification group ($P=0.03$). Gamification and flipped classes had no significant difference ($P=0.054$). There was no significant difference between the two methods of flipped class and lecture ($P=0.43$).

According to the ANOVA results, when comparing the satisfaction scores of the groups, there was no significant difference between the means of gamification in the flipped learning environment and the gamification method ($P=0.49$); however, there was a significant difference between the gamification in the flipped learning environment and the gamification with the flipped class and the lecture. Additionally, there were significant differences between the flipped class and the lecture method ($P<0.01$).

Discussions

This study aimed to compare the effects of the lecture method, flipped class and gamification in a flipped learning environment on the performance of nursing students in assessing the health status of clients. The demographic characteristics of the participants (gender, age, academic semester, grade point average and theory course score) had the same distribution among the four groups, and there was no statistically significant difference ($P<0.05$).

Comparing the results before and after the training, the results of the paired t test indicated a significant difference in the satisfaction, learning and self-efficacy of the learners ($P<0.001$). The results indicate that all four teaching methods effectively affected the learning, satisfaction and self-efficacy of students in evaluating the health status of their clients. However, in the comparison of the 4 groups, ANOVA revealed a statistically significant difference ($P<0.001$). In the analysis comparing the knowledge evaluation scores of the gamification group with those of the other methods group, there were significant differences ($P<0.05$), and there was no significant difference between the two methods (Flipped class and lecture) ($P=0.439$). According to the ANOVA results, the satisfaction scores of the groups were greater for the gamification in the flipped learning environment and gamification groups than for the flipped class and lecture groups ($P<0.01$). The results of the present research indicate that teaching methods have an effect on students' learning and satisfaction.

Rachayon and his colleagues also used a task-based learning method in combination with digital games in a flipped learning environment to develop students' English language skills, and their results also indicated the success of combining the above methods [7]. Muntrikaeo and his colleagues also used a similar model of task-based learning in combination with games in a reversed environment for teaching English, and their findings were also successful [6]. The results of the current research, which involved the integration of the gamification in the flipped learning environment for teaching health status assessment to nursing students, are similar to those of the above research.

Zou et al., in their systematic review, found that success in the flipped classroom is related to teachers' creativity in making the classroom interactive, students' readiness, and the use of technology [37]. In the present study, the flipped class, along with the use of gamification in the flipped learning environment, increased learner satisfaction and learning. Therefore, their findings are similar to the findings of the present study.

Hernon and his colleagues reported that the use of technology plays a significant role in the development of nursing students' skills [4]. Regarding the use of educational applications for health assessment, the results of their research are the same as the current research, and the use of technology not only plays a role in learning but also it has role in education satisfaction. Considering the results of the present study and similar studies, we can conclude that the use of gamification in the flipped learning environment is an interactive teaching method and can be used to improve nursing education. Gamification can increase the attractiveness of education and promote education. If a good application is designed as a flipped enviroment, it provides more time in the classroom for discussion, interaction, and scenario-based education and promotes education satisfaction.

In this study, the satisfaction with education had a significant difference between the groups, but the students' self-efficacy, despite the significant difference before and after the intervention, did not have a significant difference between the groups. Since all three studied methods were effective in students' learning and self-efficacy, it can be said that teachers can improve educational effectiveness and satisfaction by using different methods and combining them in educational situations by considering resources and conditions.

The gamification method was associated with higher satisfaction, but it requires more resources, equipment, and skilled personnel. The flipped class method requires fewer resources, is more cost-effective, and provides more time for practice and group discussion. By combining these two methods, the advantages of both can be used, which is confirmed by the results of the present study. It seems that the upside-down environment provides a good opportunity for life-long training, including the promotion of interaction and teamwork, and along

with other methods, it is also associated with more effectiveness and benefits.

In this study, knowledge and satisfaction of education had significant differences between groups, but students' self-efficacy had not significant difference between groups. Maybe it was due to the fact that we participated in the second and third semesters of nursing students, and the interactive skills of students were not assessed. So, the researchers recommended that more research be conducted with the aim of investigating interactive and communication skills using gamification in a flipped environment.

Therefore, this method is helpful in nursing education as well as other medical fields. It is suggested that this method could be combined with other educational methods, such as task-based and team-based methods, to develop the possibility of developing team-based education and task-based education. Integrated gamification methods in the flipped learning environment with mobile applications have greater attractiveness and satisfaction with effective education, and with the use of appropriate applications, it is necessary to create a sense of competition and learning. But, in this study, the interactive skills of students were not assessed. Finally it is emphasized that teachers can improve the effectiveness of education with their creativity, depending on situation, time, cost, and available resources, by using and integrating educational methods.

Conclusion

The teaching method has an effect on students' satisfaction with the teaching method, and the use of gamification in the flipped learning environment is more effective than the flipped class method, gamification, and the lecture method. Based on the results of the present research, it can be concluded that teaching methods have an effect on students' learning and satisfaction. The teaching method has an effect on the satisfaction of the students, and the use of the flipped class method with the use of gamification was associated with more attractiveness and satisfaction in addition to learning. Teachers can improve the effectiveness of education with their creativity, depending on situation, time, cost, and available resources, by using and integrating educational methods.

Limitations

Not installing the program on IOS phones made it impossible for these users to use the application and drop out study, so we recommended that designed application for android and IOS. The ability of the professor to teach with the method of gamification in the flipped learning environment and his mastery of the application are necessary to provide necessary training to the teachers regarding the above methods.

Integrated gamification methods in the flipped learning environment with mobile applications have greater attractiveness and satisfaction. But, in this study, the interactive skills of students were not assessed. So the researchers recommended that more research be conducted with the aim of investigating interactive and communication skills using the gamification method in an upside-down environment.

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

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Author contributions

VZ and RG formulates the research question that represents the systematic review objective. VZ and RG provide proposal and reports. RG collected the data. MN: Data analysis. All authors read and approved the final manuscript.

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Data availability

Data is provided within the manuscript or supplementary information files.

Declarations

Ethics approval and consent to participate

This study was approved by the ethics committee of Shahid Beheshti University of Medical Science (IR.SBMU.PHARMACY.REC.1402.152), and all methods were carried out in accordance with the research ethical codes of the Iran National Committee for Ethics in Biomedical Research. The authors guarantee that they have followed the ethical principles stated in the Declaration of Helsinki (to protect the life, health, dignity, integrity, right to self-determination, privacy, and confidentiality of personal information of research subjects) in all stages of the research. This is the online certificate of the research ethical code: https://ethics.research.ac.ir/ProposalCertificateEn.php?id=404003&Print=true&NoPrintHeader=true&NoPrintFooter=true&NoPrintPageBorder=true&LetterPrint=true. This study was registered in the Iranian Registry of Clinical Trials (https://irct.behdasht.gov.ir) on 14/12/2023, with the IRCT ID: IRCT20210131050189N7. To observe ethical considerations, School of Nursing & Midwifery of Shahid Beheshti University of Medical Sciences agreed to participate in the study; the research goals and procedures were elucidated to the participants, the participants were assured of information anonymity and confidentiality, and informed written consent was obtained from each participant and documented. They participated in the study voluntarily and could leave the study at any stage.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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