The Effect of the Flipped Classroom Model on Teaching Clinical Practice Skills

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Contribution to Emergency Nursing Practice

- Medical errors experienced during the delivery of health care negatively affect both health workers and patients. Medical errors can occur, because of many reasons such as inadequate education.
- With this study, for the first time in the literature, the flipped classroom model was used on 5 different applications and was done with paramedic program students.
- The flipped classroom model can be used as an alternative method to the traditional system in teaching clinical practice skills.

Abstract

Introduction: No evidence was found in the literature for the use of the flipped classroom model in teaching clinical practice skills in paramedics. The study aimed to determine the effect of the flipped classroom model in teaching clinical practice skills to paramedic program students.

Methods: The study was a single-center, randomized controlled, single-blind parallel-group study. The research was carried out with a university's first-year paramedic program students in the 2021 to 2022 academic year. The students were divided into groups by stratified sampling (intervention group = 21, control group = 21). Five clinical skills practices at various times were explained to the intervention group with the flipped classroom model and to the control group with the traditional lecture method. The research data were collected with the Introductory Characteristics Information Form, Checklists, Time Tracking Form, and Students' Questionnaire for Evaluating the flipped classroom model.

Results: Although the students in the intervention group received a higher total score from all 5 clinical practice skills than the students in the control group, this difference was not statistically significant ($P > .05$). However, although the time allocated for applications in the intervention group was 40 to 75 minutes longer than in the control group, most students stated that this model successfully taught skills and theory, increased their motivation during the application, and reduced application and exam anxiety.

Discussion: The flipped classroom model can be used as an alternative method to the traditional system in teaching clinical practice skills. This innovative educational approach can be recommended as a student-centered method in clinical skills teaching.

Key words: Education; Flipped classroom; Learning strategies; Nursing; Clinical practice skills

Introduction

Teaching clinical practice skills has a key place in the education of health professionals. These skills contribute to shaping the professional identities of the students who are the professional health workers of the future.[1] Clinical skill is a complex action that requires a critical attitude by adapting theoretical knowledge to each patient and situation based on scientific evidence.[2,3] This situation requires health professionals to be constantly aware

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of developments in this field. Students should be given the opportunity to develop their knowledge and competence performance in skills education by using innovative education methods.[4]

Innovative teaching methods emphasize problem-solving, reasoning, putting theory into practice, and student-centered learning, especially for students in hands-on education such as health programs. Strategies for student-centered learning have shown themselves intensely in teamwork and case-based learning models. In conjunction with these models, the flipped classroom model (FCM) has been found to be an opportunity for students to take an active role both inside and outside the classroom, take responsibility for learning, and use information and communication technologies. The FCM has been a preferred learning method in various programs recently, and its use is increasing.[5-7]

In the FCM, students are given access to the lesson content before the classroom environment through written, audio, and video materials. At this stage, called prestudy, students are given a primary education with material depending on their learning speed. Afterward, students participate in interactive activities such as small group discussions and case scenarios to apply what they have learned.[6,8] In addition, it has been reported that FCM can improve individual inquiry, collaborative effort, social interaction, and independent learning skills.[9,10]

Before technological innovations, traditional presentation methods such as textbook reading and slide shows were used widely.[11-13] However, it has been reported that this approach causes attention deficit in students and is insufficient in developing students' clinical practice skills.[13,14] In line with these results, it is seen that the traditional education approach cannot meet the needs of students in transferring and acquiring knowledge. Depending on the use of the conventional education approach in health programs, theoretical knowledge is transferred to students in the classroom environment, and limited time is left for laboratory studies that improve their learning skills. Various activities are given to students as homework, and students are left alone with the responsibility of absorbing and consolidating knowledge. In the FCM, activities inside and outside the classroom change places.[13] In the traditional education approach, although the time spent by the teacher with the students in a classroom after the subject is taught is approximately 20 to 35 minutes, this time is 75 minutes on average in the classrooms where FCM is used.[10]

In curricula where clinical practice skills are intense, such as health programs, FCM allows students to practice more in the classroom environment. However, in a systematic review, it is recommended that more experimental studies be conducted to prove the effectiveness of FCM.[15] Considering the studies in the field of health in the literature, there is evidence for the use of FCM in medicine and nursing education. However, in these studies, the effect of this training method used on only 1 clinical practice skill (respiratory system, urinary system) was evaluated.[16,17] However, there is no evidence of its use in the paramedic program, which is one of the departments where the health personnel who make the first intervention to the patient are trained and which takes the most practice. This study aimed to determine the effect of the FCM in skills performance with paramedic students.

Methods

TRIAL DESIGN

Consolidated Standards of Reporting Trials, 2010, were followed to report the research. This research is a single-center, randomized controlled, single-blind, parallel-group study conducted in Turkey. The clinical trial registration number is NCT05402215.

ETHICAL

Before collecting the research data, permission was obtained from the local ethics committee (04.10.2021-61) and the institution where the research would be conducted. During the data collection phase, information about the research was communicated verbally and in writing to the students. Written informed consent whereby they agreed to participate in the research was obtained. The ethical principles of the Declaration of Helsinki were complied with at all stages of the study. The students were informed that the same lesson subjects would be taught in both groups. At the same time, it was assured that the data obtained would be confidential and that the lesson grades of the students who did not participate in the study would not be affected. In addition, they were informed that they could withdraw from the study at any time.

PARTICIPANTS

The research was conducted in the paramedic program at a state university in Turkey. The paramedic program, whose training period is 2 years, includes practical lessons such as Emergency Patient Care, Emergency Aid and Rescue Studies, Basic and Advanced Life Support, and Ambulance

TABLE 1
Distribution of stratified randomization variables between groups ($n = 42$)

Characteristics	Experimental group ($n = 21$) (Mean ± SD) or n (%)	Control group ($n = 21$) (Mean ± SD) or n (%)	Test value	*P*
Grade point average	2.83 ± 0.50	2.87 ± 0.46	−0.225*	.823
The school they graduated from				
Health vocational high school	4 (76.2)	5 (66.7)	0.141†	.707
Other	17 (23.8)	16 (33.3)		

* Independent groups *t* test.
† Pearson's chi-square test.

Service Training Applications. Clinical practice skills are included in the content of the emergency patient care lesson. Graduates work in emergency health care units of other institutions and organizations, especially health institutions.

The data were collected within 1 year, in the Fall and Spring semesters of the 2021 to 2022 academic year. The study population consisted of 49 students who enrolled in the 2021 to 2022 academic year paramedic program, studied in the first year, and chose the lesson in which clinical practice skills were explained. Sample selection was not made in the study, and we aimed to reach the entire study population. A total of 3 students were not included in the study, because 2 students had previously taken the lesson on clinical practice skills and 1 student refused to participate in the study. For this reason, the research started with 46 students, a 93.9% representation of the study population.

RANDOMIZATION

To ensure the homogeneity of the research groups, the students were assigned to the groups by stratified randomization method. In randomization, students' grade point average and the characteristics of the school they graduated from were taken as a basis. The total score average for the grade point average and the categorical distribution for the school they graduated from were considered. In order to reduce selection bias, randomization was made by a person other than the researchers using the Excel (Microsoft) program, and 23 students were assigned to the intervention group and 23 to the control group. No statistically significant difference was found between the study groups regarding the variables used in stratified randomization (Table 1).

Two students in each group were excluded from the study during the research process because of lateral transfer and dropout. Therefore, the study was completed with 21 students in each group (Figure 1). After the data collection phase was completed, using G*power 3.1 (Franz Faul, Universität Kiel, Germany), the sample size was determined to be sufficient by finding power = 0.92 in the post hoc analysis performed with a 5% type 1 error, taking the mean scores of the clinical practice checklist as a reference.

SURVEY TOOLS

The data of the study were collected using the "Introductory Features Information Form" containing the introductory information of the students, the "Clinical Practice Skill Videos and Checklists" containing the clinical practice skill steps, the "Time Tracking Form," and the "Student's Questionnaire for Evaluating the Flipped Classroom Model."

Introductory Features Information Form

The researchers prepared the introductory characteristics information in the light of the literature to define the characteristics of the intervention and control group students.[9,10,18] The form consists of 7 questions, including the characteristics of the students' age, gender, chronic illness, grade point average, financial situation, place of residence during university education, and family type.

Clinical Practice Skill Videos and Checklists

Among the most common practices performed by health care professionals are intravenous (IV) catheterization, IV blood collection, blood pressure measurement from the brachial artery, intramuscular (IM) injection into the ventrogluteal region, and urinary catheterization in

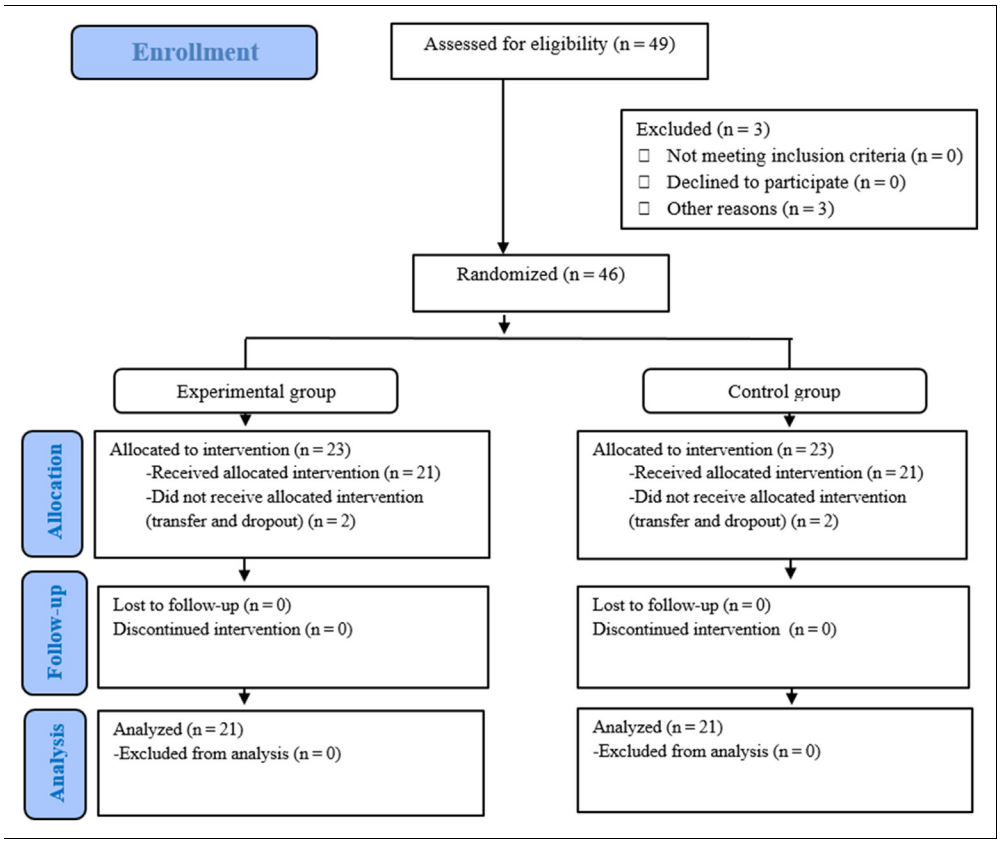


FIGURE 1

Consort flow diagram. CONSORT, Consolidated Standards of Reporting Trials.

women.[19,20] For this reason, these most frequently applied skills were preferred in the study.

Clinical Practice Skill Videos and Checklists were prepared by researchers using clinical practice guidelines and expert opinion was taken from 3 academicians in the field of nursing fundamentals.[21,22] Experts were asked to evaluate the videos and checklists. It was concluded that the videos after the evaluation could be used in the education of the students in the intervention group and that the checklists were appropriate for skill evaluation. In the study, IV catheterization (28 administration steps), IV blood collection (24 administration steps), blood pressure measurement from the brachial artery (24 administration steps), IM injection into the ventrogluteal region (34 administration steps), and female urinary catheterization (5 checklists containing skill steps of 39 application steps) were used. In the checklists, each application step was arranged in a 3-point Likert scale as "applied" (2 points), "applied incompletely" (1 point), and "did not apply" (0 points). The lowest score in the checklists was 0, and the highest score differed according to the number of skill steps in clinical applications.

Time Tracking Form

The researchers created the form to determine the time allocated for each clinical practice lesson's theoretical and practical parts in the intervention and control groups. The lecturer filled out the form after each lesson.

Student Assessment Questionnaire for the FCM

The researchers developed the questionnaire so that the students in the intervention group could evaluate the clinical practice skill process they received with FCM at the end

TABLE 2
Introductory characteristics of the students (*n* = 42)

Characteristics	Experimental group (*n* = 21) Mean ± SD or n (%)	Control group (*n* = 21) (Mean ± SD) or n (%)	Total (*N* = 42) (Mean ± SD) or n (%)	Test value	*P*
Age	20.09 ± 1.26	20.04 ± 086	20.07 ± 1.06	0.143*	.887
Grade point average	2.83 ± 0.50	2.87 ± 046	2.85 ± 0.48	–0.225*	.823
Gender					
Female	16 (76.2)	14 (66.7)	30 (71.4)	0.467†	.495
Male	5 (23.8)	7 (33.3)	12 (28.6)		
Chronic disease					
Yes	2 (9.5)	1 (4.8)	3 (7.1)	0.359‡	.549
No	19 (90.5)	20 (95.2)	39 (92.9)		
Place of residence during university education					
Dormitory	6 (28.6)	7 (33.3)	13 (31.0)	1.135‡	.567
House	13 (61.9)	10 (47.6)	23 (54.8)		
With family	2 (9.5)	4 (19.0)	6 (14.3)		
Financial situation					
Income less than expenses	9 (42.9)	8 (38.1)	17 (40.5)	1.059‡	.589
Income equals expense	12 (57.1)	12 (57.1)	24 (57.1)		
Income more than expenses	0 (0.0)	1 (4.8)	1 (2.4)		
Family type					
Nuclear	19 (90.5)	17 (81.0)	36 (85.7)	0.778	.378
Extended	2 (9.5)	4 (19.0)	6 (14.3)		

* Independent groups *t* test.
† Pearson's chi-square test.
‡ Fisher's chi-square test.

of 1 year. There were 5 questions in the survey. Survey questions were answered as "yes," "partly," or "no."

OUTCOME CRITERIA

After randomization, the "Descriptive Characteristics Information Form" was applied to determine the descriptive characteristics of the students in both groups. Checklists were filled in during the applications at various times, depending on the lesson curriculum. At the end of the 1-year period, the "Students' Evaluation Questionnaire for the Flipped Classroom Model" was applied to determine the students' thoughts on FCM. The students were given the forms and were requested to answer them.

The primary outcome was the practice skill score determined by checklists. The secondary result was the time allocated for theoretical explanation and practice teaching clinical practice skills determined by the follow-up chart. The tertiary outcome was the intervention group students' feedback on the FCM.

APPLICATION OF RESEARCH

The data of the study were collected during the COVID-19 pandemic. Therefore, the protective equipment recommended by the Ministry of Health to be used in the education process also was used in the data collection process. After the sample group was determined, a face-to-face meeting was held with the students. The applications to be made during the process were explained, and the questions the students were curious about were answered. Afterward, students were given an introductory feature information form, and they were asked to fill in the forms.

TABLE 3
Distribution of students' scores from checklists in clinical practice skills ($n = 42$)

Clinical practices	Experimental group ($n = 21$)			Control group ($n = 21$)			Test value*	*P*
	Mean ± SD	Min	Max	Mean ± SD	Min	Max		
IV catheterization	47.14 ± 3.18	39	53	45.71 ± 3.00	41	54	1.496	.142
IV blood collection	43.90 ± 2.02	40	46	42.76 ± 1.86	39	46	1.902	.064
Blood pressure measurement from the brachial artery	39.62 ± 2.87	32	44	39.61 ± 2.55	35	46	−0.284	.778
IM injection to the ventrogluteal region	51.22 ± 6.81	40	63	51.19 ± 7.36	34	62	−0.065	.948
Urinary catheterization in women	59.57 ± 7.89	46	73	59.52 ± 8.42	40	72	0.019	.985

IM, intramuscular; IV, intravenous; Max, maximum; Min, minimum.
* Independent groups *t* test.

While FCM was used in teaching clinical practice skills to students in the intervention group, the traditional lecture method was used in the control group. Each clinical skills practice was made in the weeks determined according to the lesson curriculum. The videos that the researchers had previously prepared for clinical skills practices were shared with the intervention group students 1 week before each clinical skills practice lesson day for prestudy purposes, and the students were asked to work on these videos. On the day of the lesson, the researcher (instructor conducting the lesson) conducted group work, question-answer, and discussion activities with the students in the classroom environment. The clinical skills practices were explained to the students in the control group by the researcher (instructor conducting the lesson) using presentation and demonstration methods. In the intervention and control groups, time was kept by the researcher to determine the time allocated for the theoretical and practical parts of each clinical practice lesson. At the end of each clinical skills practice lesson, students in both groups were asked to apply clinical skills practice on simulation models of the application.

While the students were completing the clinical skills practices, one of the researchers observed the clinical skills practices and marked only the skill level in the checklists ("applied," "incompletely applied," and "did not apply") without any comment or direction. The checklists were filled by another researcher who did not know which group the students belonged to in order to reduce the risk of bias.

EVALUATION OF DATA

The statistical package program evaluated the data obtained from the research in the computer environment SPSS Statistics 23.0 (IBM Corp, Armonk, NY). The normal distribution of numerical data was examined with the Shapiro-Wilk test of normality. Descriptive data were shown as numbers, percentages, and averages. Comparisons of numerical data between groups were made with an independent sample *t* test, and comparisons of categorical data were made with Fisher's or Pearson's chi-square analysis according to distribution. The comparison of the scores obtained from the checklists between groups was made with the independent sample *t* test. In all comparisons, the results were evaluated with a 95% confidence interval, and $P < .05$ was considered significant.

Results

A total of 42 students participated in this study. Table 2 shows the introductory characteristics of the students in the intervention and control groups. The students in the intervention and control groups did not have any statistically significant differences in age ($P = .89$), grade point average ($P = .82$), gender ($P = .50$), chronic illness ($P = .55$), place of residence during university education ($P = .57$), financial situation ($P = .59$), and family type

TABLE 4
Distribution of the time allocated to theoretical explanation and practice according to the groups ($n = 42$)

Clinical practices	Experimental group ($n = 21$)		Control group ($n = 21$)	
	Time used for theoretical lecture	Time used for practice lecture	Time used for theoretical lecture	Time used for practice lecture
IV catheterization	25	135	80	80
IV blood collection	20	140	80	80
Blood pressure measurement from the brachial artery	55	105	120	40
IM injection to the ventrogluteal region	25	135	90	70
Urinary catheterization in women	50	110	120	40

IM, intramuscular; IV, intravenous.

($P = .38$). These results show that the 2 groups are homogeneous regarding introductory characteristics.

The distribution of the scores obtained by the students from the checklists applied during their clinical practice skills is given in Table 3. IV catheterization ($P = .14$), IV blood collection ($P = .21$), blood pressure measurement from the brachial artery ($P = .78$), IM injection to the ventrogluteal region ($P = .95$), and urinary catheterization in women ($P = .99$) of the students in the intervention and control groups were found to have similar total scores from practice skills and no statistically significant difference.

Table 4 shows the distribution of the time allocated to theoretical explanation and practice teaching clinical practice skills according to the intervention and control groups. In the intervention group, the time allotted for practice after the lecture was 135 minutes for IV catheterization, 140 minutes for IV blood collection, 105 minutes for blood pressure measurement from the brachial artery, 135 minutes for IM injection into the ventrogluteal region and urinary tract in women, and 110 minutes for catheterization. In the control group, it was determined that the time allocated for the application was lower in all 5 clinical applications.

Table 5 shows the distribution of the students' views on FCM in the intervention group. A total of 90.5% of the students stated that FCM's clinical practice skills were successful in teaching skills, 95.2% of them said that FCM was successful in the theoretical teaching of clinical applications, 66.7% of them stated that FCM reduced the anxiety experienced during laboratory application, 76.2% said that FCM increased your motivation for the clinical practice skills lesson, and 52.4% of them stated that FCM's clinical practice skills lesson reduced test anxiety.

Discussion

Health services are the priority of all countries. However, medical errors experienced during the provision of the service negatively affect both health care professionals and patients. Medical errors can occur because of many reasons. The leading causes of medical errors are grouped under 3 headings: institutional factors, technical factors, and human-related factors such as lack of communication, lack of time, wrong decision, and insufficient education.[23] One of the ways to prevent these mistakes is to ensure that students thoroughly learn the practices in the education process and have the equipment to apply them in their professional life. For this, it is recommended to use innovative training methods.[10,24]

The data obtained from this study, which was conducted to determine the effect of FCM on students' learning clinical practice skills compared with the traditional teaching method, were compared with the literature.

Although the total score average of the students in the intervention group in the skills of IV catheterization, IV blood collection, blood pressure measurement from the brachial artery, IM injection to the ventrogluteal region, and urinary catheterization in women was higher than that of students in the control group, there was no statistically significant difference between the groups ($P > .05$; Table 3). There are studies with comparable results in the literature. Similarly, in a study conducted on nurses using FCM, it was found that there was no significant difference between the 2 different teaching methods.[25] There are also studies demonstrating the effectiveness of the FCM on clinical skills. In their study, Aksoy and Gurdogan[17] demonstrated that FCM effectively improves urinary system

TABLE 5
Distribution of the students in the intervention group about FCM ($n = 21$)

Questions about FCM	Yes n (%)	Partially n (%)	No n (%)
Do you think FCM is successful in teaching skills of clinical applications?	19 (90.5)	1 (4.8)	1 (4.8)
Do you think that FCM is successful in the theoretical teaching of clinical applications?	20 (95.2)	0 (0.0)	1 (4.8)
Do you think that FCM reduces the anxiety you experience during laboratory practice?	14 (66.7)	5 (23.8)	2 (9.5)
Do you think that FCM increases your motivation for the clinical practice skills lesson?	16 (76.2)	4 (19.0)	1 (4.8)
Do you think that FCM's clinical practice skills lesson reduces test anxiety?	11 (52.4)	6 (28.6)	4 (19.0)

FCM, flipped classroom model.

knowledge and skills. In studies conducted with the FCM in the surgical field and on drug applications, it was found that the model significantly affected theoretical knowledge and clinical practice skills.[26,27] As a result, when the data obtained from the study are compared with similar studies in the literature, it is thought that FCM can be used in teaching clinical practice skills.

Studies show that FCM allows teachers to devote more time to their students to explore the practice during the lesson.[18,24,28] Students need support and time to transfer the knowledge they have learned to practice during the lesson. Our study determined that the time allocated for the application was higher in the intervention group than in the control group (Table 4). However, the fact that the students in the intervention group practiced longer than the control group was not statistically significant in terms of their total score averages from clinical practice skills. This may be, because students are evaluated in their first laboratory practice. In other words, in our study, an average of 5.95 minutes was allocated to each student in the intervention group in the first application. During this time, they were both given the opportunity to practice and evaluated according to the checklists. The students in the control group were asked to practice for an average of 2.95 minutes, and the checklists were filled out. Therefore, it is thought that there is no statistical difference in terms of clinical practice skills, but the time allocated to the practices in the groups may be effective in the success of the students.

Students in the intervention group stated that FCM successfully taught skills and theory of clinical practices, reduced anxiety experienced during laboratory practice, increased motivation for practices, and decreased anxiety about clinical practice skills exams (Table 5). In the literature, it has been shown that FCM increases students' participation in the lesson, their interaction with teachers and peers, and their attention span, and provides opportunities to receive simultaneous feedback.[29] In another study, it was stated that statistically significant findings could not be reached, but students saw FCM as an acceptable approach.[16] In line with the answers given by the students in the intervention group about FCM, it was concluded that this innovative approach is an effective method on teaching clinical practice skills.

The COVID-19 pandemic has led to the cessation of face-to-face education in institutions and the start of digital developments in education.[30-32] Various international organizations have recommended using distance education programs and open access platforms to reduce disruption to the learning process.[33] In a study investigating the effect of FCM in online education, it was stated that the model was effective in learning.[34] In line with the information obtained from these research findings and the literature, it is thought that FCM can be preferred by educators in both face-to-face and online education.

Strengths and Limitations

There is limited information in the literature on the use of FCM in the curriculum of health programs. The study's strengths are that the model is made for 5 different applications and that it is the first study in the literature on its use in paramedic program. However, the study also has some limitations. The research was conducted in a single institution with a small number of sample groups. The study focused only on the difference between FCM and traditional teaching methods rather than multiple learning approaches. Therefore, it cannot be generalized to all students in the health program where clinical practice skills are taught.

Implications for Emergency Nurses

It is vital that the applications are carried out effectively in emergency services and in the prehospital area. Nurses and paramedics working in these areas need to receive well-equipped training. Therefore, innovative approaches have an important place in the process of learning clinical practice skills of paramedic program students.

With this study, for the first time in the literature, the FCM was made on 5 different applications and was used on paramedic program students. It has been proven that the FCM can be used as an alternative method to the traditional system in teaching clinical practice skills.

Conclusion

The total scores of the students in the intervention group for IV catheterization, IV blood collection, measuring blood pressure from the brachial artery, IM injection to the ventrogluteal region, and applying urinary catheterization in women, and the time allocated for the application were higher than those in the control group. The students in the intervention group stated that FCM successfully taught skills and theory of clinical practices, reduced the anxiety experienced during laboratory practice, increased the motivation for the practices, and decreased the concern about the clinical practice skill exam. These results support that FCM can be used in teaching clinical practice skills.

The FCM is used in this example to teach clinical skills but also can be used to teach didactic or conceptual knowledge. For example, it also can be used in the teaching of other clinical practice skills such as shock, triage, and head injury. In addition, it is recommended to evaluate the long-term effects of the model and compare it with other training models in future studies.

Data, Code, and Research Materials Availability

Clinical Trial Registration Number: NCT05402215. Clinical Trial Registration Name: The Effect of the Flipped Classroom Model on Teaching Clinical Practice Skills registration link: https://clinicaltrials.gov/ct2/show/NCT05402215?term=Ali+KAPLAN&draw=2&rank=3.

Author Disclosures

Conflicts of interest none to report.

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