Original Article

The effect of blended learning on the learning level of nursing students and the educational environment during pharmacology clerkship

Mohammad Ali Montaseri[1], Shohreh Javadpour[1], Somayeh Ramezanli[2], Zohreh Badiyepeymaiejahromi[3]*

[1] Instructor, Department of Nursing, School of Nursing, Jahrom University of Medical Sciences, Jahrom, Iran.
[2] PhD. Student in Nursing, Student Research Committee, School of Nursing and Midwifery, Shiraz University of Medical Sciences, Shiraz, Iran.
[3] Assistant Professor, Department of Nursing, School of Nursing, Jahrom University of Medical Sciences, Jahrom, Iran.

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***Corresponding author:**
Zohreh Badiyepeymaiejahromi Assistant Professor, Department of Nursing, School of Nursing, Jahrom University of Medical Sciences, Jahrom, Iran.
Email: z.badiyepeyma@gmail.com

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Abstract

Background & Objective: Pharmacology is an important educational course in nursing education; however, the conventional curricula have not provided students with sufficient opportunities to improve their pharmacology knowledge and skills. This study aimed to determine the effect of blended learning on the learning level of nursing students and the educational environment in pharmacology clerkship.

Materials & Methods: This quasi-experimental study was conducted on 30 undergraduate nursing students supposed to enroll in the pharmacology clerkship course in 2021 at the Jahrom University of Medical Sciences. All students participated in eight educational sessions using blended learning (electronic and conventional education). A self-assessment questionnaire was used at the beginning and end of the clerkship course to assess familiarity with the educational goals. The formative assessment score and final "Objective Structured Clinical Examination" (OSCE) score were used to assess the students' learning level. At the end of the course, the educational environment of the clerkship was evaluated using the Dundee Ready Educational Environment Measure (DREEM) instrument. The data were analyzed using descriptive and inferential statistics, including paired t-test, as well as Pearson and Spearman correlation coefficients.

Results: The paired t-test results showed a significant difference in the mean score of achieving educational goals before and after the intervention (P>0.001, t=6.36). The mean of formative assessment and end-of-course OSCE scores were 83.66±7.51 and 83.26±7.09, respectively (out of 100). The mean score of the educational environment of the pharmacology clerkship was also reported as 98.5±18.86 (out of 170).

Conclusion: The results showed that blended learning led to a desirable level of achieving the educational goals and environment during the pharmacology clerkship. It is suggested to use blended learning along with the clinical educational goals to improve the students learning.

Keywords: Blended learning, Clinical education, Clinical clerkship, Educational goals, Nursing students, Pharmacology

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Introduction

Students' empowerment to accept important roles in the nursing profession is among the missions of nursing faculties. Pharmacological knowledge is regarded as a remarkable part of nurses' clinical practice, and nurses should get sufficient levels of knowledge in pharmacology to provide patients with safe and high-quality care (1). Nurses play diverse and multifaceted roles in medication administration, which includes patient assessment, knowledge of medicines, patient safety issues (e.g., medication dosage miscalculations), medication dosage calculations, different medicine

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administration techniques, monitoring expected and adverse medication effects, and patient education. Research shows that medication errors are increasing, and this issue has raised concerns about the knowledge and skill of nurses (2). Considering that pharmaceutical knowledge is of critical importance in providing nursing care, little attention has been paid to pharmacology education and learning by instructors and students (3). In a study at educational institutions in the UK, approximately 25% of the nurses stated that most of the courses in the instructional curriculum must be dedicated to pharmacology education and learning (3). The evaluations also reveal that the nursing students have dissatisfying knowledge of pharmacology, and they are not satisfied with the present educational methods since they do not increase the retention rate and are not effective enough (4).

According to the results of previous studies, blended learning is considered the best and most complete instructional method to increase motivation, broaden experience, and make students more active in the clinical environment (5). This educational approach integrates technology and digital media with traditional instructor-led classroom activities, eliminating the traditional teaching-learning challenges (6). The blended learning uses different educational strategies and learning patterns which make it effective in increasing the students' learning level (7, 8). In nursing education, blended learning is rapidly becoming a standard method for providing students with the course material (9). The studies on nursing education regarded blended learning as a community-oriented and basic method for continuous and spontaneous education. This type of education relies on the interest and personal characteristics of the learners. In addition, by considering motivation and experience, it activates the students and cultivates responsibility, independence, self-confidence, critical thinking, and creativity among students to do clinical tasks (10).

Penvalas et al. employed blended learning to teach pharmacology, make pharmacology learning easier, as well as improve communication skills and interpersonal relationships. According to the results, the instructors and students showed high levels of satisfaction with this method (11). So far, plenty of studies have been conducted on the effectiveness of this method in nursing education, and most of them have shown the positive effect of this educational approach on students' learning (12,13). This approach involved some drawbacks (14); therefore, it is necessary to conduct more research on the use of blended learning in the education of nursing students, especially clinical education.

Educational content learning is directly correlated with the educational environment. The World Federation for Medical Education has considered the educational environment one of the important components in the evaluation of educational programs. Therefore, it is recommended to assess the educational environment as an indicator of the quality management process and the rate of students' success and satisfaction with the educational approach. The educational environment as a determinant of behavior expresses the students' perception of their surroundings, which affects their academic progress and learning (15). The quality of an educational environment indicates the effectiveness of an educational program in the students' motivation and learning. The evaluation of the educational environment is the most widely used and accessible method to assess the students' understanding of this issue (16).

Bakshi et al. conducted a study on the nursing students at the Rafsanjan University of Medical Sciences in 2012, and the results revealed a positive educational environment at the university, although certain domains needed some improvements. It is necessary to make more efforts to create a suitable educational environment in order to provide students with high-quality instructional curricula (17). Using conventional instructional methods, the pharmacology clerkship course in nursing could not provide students with a reliable approach to achieving broad professional goals. There is a dearth of research on the use of blended learning in clinical pharmacology education, and most of the previous studies have used this approach in theoretical courses. With this background in mind, the present study aimed to investigate the effect of blended learning on the learning level of nursing students and the educational environment in pharmacology clerkship.

Materials & Methods

Design and setting(s)

This quasi-experimental study (pre-test/post-test without a control group) was conducted in the first

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semester of the academic year 2021-22 at the Jahrom University of Medical Sciences.

Participants and sampling

The study population included second-year undergraduate nursing students in the Nursing School of the Jahrom University of Medical Sciences in the first semester of the academic year 2021-22. Considering the research population, the sample size was determined at 30 nursing students who were selected by the convenience sampling method and were supposed to enroll in the pharmacology clerkship course. All students were included in the study by census method and were divided into 5 groups of 6 students per group to implement the intervention.

It should be mentioned that these students had passed the course of principles and skills of nursing and were familiar with the principles of pharmacotherapy. The inclusion criteria were nursing students at the Jahrom University of Medical Sciences (third semester), intention to enroll in a pharmacology clerkship course, and willingness to participate in the study. The exclusion criteria involved the students who were unwilling to continue the participation, the cases who were absent in more than one session during the clerkship period or the final exam, and those who delivered incomplete questionnaires. It is worth mentioning that all students participated in the study, and there was no sample drop.

To start the research procedure, a face-to-face workshop was held in the first session of the course to familiarize the students with the educational method and present the course plan (objectives and educational program, assessment method, and resources used). The instructor in charge of the course also explained all the issues, and the students were informed about the research stages. Subsequently, the informed consent form was got from the students, and they were asked to complete the self-assessment questionnaire on familiarity with the educational objectives. The students were then randomly divided into 5 groups of 6 students per group.

Based on the student number, the lottery was done, and the number of the first person extracted was in group one and the number of the second person extracted was in group two. The lottery continued in the same way until the members of five groups were identified. Students participated in eight pharmacology educational sessions in rotation in the internal and surgical wards. After the clerkship, the students completed the post-test and the educational environment questionnaire. The clinical instructors were requested to report the performance assessment score of the students during the clerkship in the wards.

In order to evaluate the participants at the end of the course, the "Objective Structured Clinical Examination" (OSCE) was conducted. The course instructors who were all proficient in the OSCE exam designed the exam. During several meetings, the specifications, checklists, determination of the passing grade limit, and how to implement and monitor the exam were determined.

According to the students' learning priorities, the exam was designed using 15 stations, each lasting 5 minutes (18). Instructors of the clerkship course designed the station scenarios, and they were reviewed and evaluated in a group comprising professors and instructors. Students were asked to perform a procedure or answer descriptive questions about a scenario in the stations. The assessment checklist of each station was also extracted based on a book entitled "Principles and Techniques of Nursing Procedures". The items in the checklists were rated based on a score of 0 (not done), 0.5 (to some extent), and 1 (completely done). At the beginning of the OSCE exam, all students were quarantined in a hall near the test center, and a supervisor accompanied them during the quarantine period. Afterward, all the students entered the test center individually and after passing through all the stations from 1 to 15, they were directed out of the center.

This exam was held in one day, and checklists were used to score the test (after the clerkship, the educational environment of the pharmacology clerkship was assessed using the Dundee Ready Educational Environment Measure (DREEM) instrument (24, 25), and the self-evaluation questionnaire was also completed as a post-test (Diagram 1).

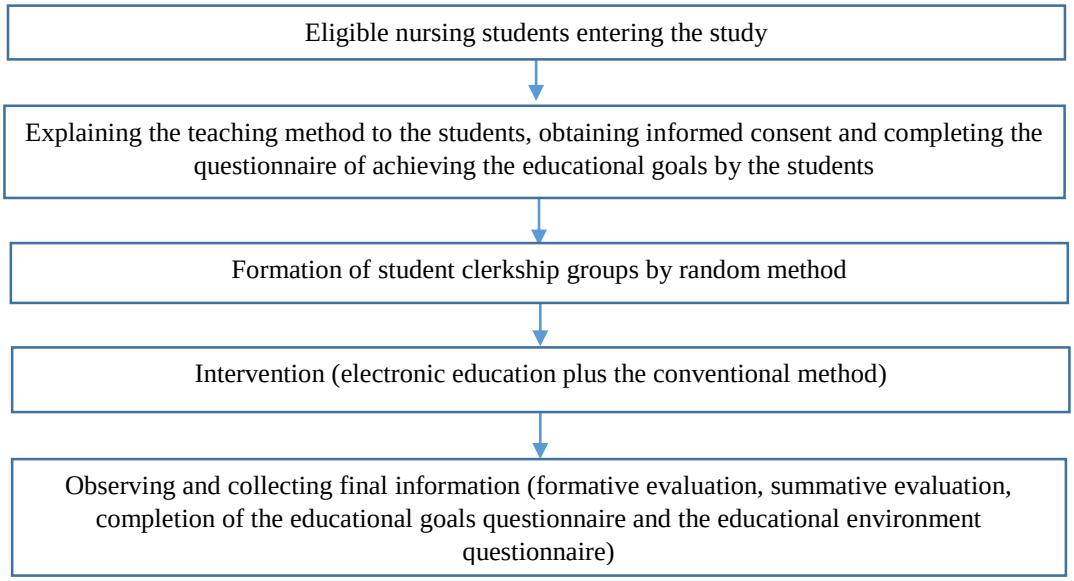


Diagram 1. Research Design Algorithm

Tools/Instruments

When the students started the clerkship course, the instructor explained all the procedures and policies, especially medication administration. In the blended learning used in this study, specific educational tasks were given to students under educational goals to empower them every day. Following that, the students studied and answered the questions by the use of electronic educational resources. At the end of each day during the clerkship course, the students' questions were raised in the group, and the students engaged in group discussion and provided the correct answer.

Electronic education was used along with conventional education, and during the clerkship shifts, each student administered medications to two patients under the supervision of the instructor, who was required to check the patients' medicine cards with Kardex and then prepare the medicines. Before administering the medication, the student reviewed the chief complication of the patients and evaluated the patients' medicines, the reason for prescription, and principle care in medication. The instructor provided all the educational opportunities and aspects for the students to achieve the educational goals in the course under his/her supervision.

Also, meetings were held at the beginning and during the academic semester with the instructors of the pharmacology clerkship course regarding the uniformity of the educational method, content, and how to evaluate the students (Table 1).

The electronic education approach was used in all educational rotations employing the contents of the website of the Clinical Skills Center of the School of Nursing (19), the portal of the Vice-Chancellor for Food and Drug, the Jahrom University of Medical Sciences (20), and Darooyab website (21). Pharmaceutical posters (22), drugs storage instructions, medicines that are similar in sound or writing, and antidotes were available on the website of the Clinical Skills Center of Nursing School, Jahrom University of Medical Sciences (the menu of educational posters). In the nursing menu (pharmacology training section), there was information available in terms of instructions for administering medications; educational items for administering medications by mouth; drawing medication out of a vial; withdrawing medication from an ampoule; intramuscular injection; intradermal injection; subcutaneous injection; and administering medication via a gastric tube, spray, ointment, eye drops, nose drops, eardrops, and rectal suppositories. Because of the limited number of qualified participants in this study, it was attempted to get the informed consent of all students to prevent sample attrition during the study. Efforts were also made to make the participants follow the provided instructions and implement the intended intervention based on the research procedure so that accurate results can be got from the study sample. In addition, the researchers tried

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to avoid wasting time analyzing and interpreting the data, as well as reporting the results.

Table 1. Pharmacology clerkship training program

Clerkship days	Conventional method	Electronic education
first day	Familiarity with different drug prescriptions, identification of different drug forms and dosages	Familiarity with different forms and dosages of drugs, familiarity with brand names and generic names of drugs
second day	Performing the principles of medication administration step by step, Teaching how to regulate serum containing drugs	Teaching the principles of medication administration step by step
third day	Performing the principles of drug therapy step by step Teaching how to regulate serum containing drugs	Teaching the concept of Stat and PRN dosage
fourth day	Teaching and performing the principles of intravenous injection of drugs	Teaching the appropriateness of pharmaceutical units and converting different pharmaceutical units to each other
fifth day	Teaching the principles of injecting subcutaneous and intramuscular drugs	The importance of keeping capsul, drug vial, drug cover and syringe cover during medication administration
sixth day	Teaching different methods of prescribing oral and sublingual drugs	Teaching the special conditions of storing medicines at room temperature and in the refrigerator
seventh day	Teaching the principles of using sprays and nebulizers, ointments, drops and suppositories	Teaching how to prepare and prescribe narcotic drugs and special drugs
Eighth day	Teaching how to record medication orders on Kardex, medication card, medication registration sheet and nursing note	Teaching different ways of examining the patient's response to drug therapy

Data collection methods

A self-evaluation questionnaire of familiarity with educational goals, formative assessment scores, and summative assessment scores (final OSCE exam score) were used to assess the students' learning based on blended learning. Before the beginning and after the clerkship, students' self-evaluation was conducted using a 30-item researcher-made questionnaire measuring the students' familiarity with the clerkship goals rated on a five-point Likert scale from very low (0) to very high (4). The score range of this questionnaire was between 0 and 120. The face and content validity of this questionnaire were confirmed in this study. In the beginning, the opinions of 5 undergraduate nursing students and 7 professors were used to qualitatively check the face validity in terms of difficulty, appropriateness, and ambiguity of the items. Following that, content validity was conducted using the opinions of professors (n=7) and nursing students (n=5).

The content validity ratio (CVR) and the content validity index (CVI) were used to check the content validity. In determining the CVR of the questionnaire, according to Lawshe 1975, the experts were asked to express their opinion about each item using "necessary", "not necessary but useful", and "not necessary". Accordingly, 56% was determined by the number of these experts (n=12). After receiving experts' opinions and evaluating CVR for each item considering the minimum value of content validity ratio of 56%, all the items got scores above the minimum value, and there was no need to eliminate any items.

In order to evaluate the CVI, the relevance of the items was assessed using a four-point Likert scale by a panel of experts, including 7 professors and 5 nursing students. In this method, the CVI score was above 79%, and since the CVI of all items was above 86%, no item was eliminated from the questionnaire. At the end of the content validity assessment, 30 items remained. In order to assess the reliability, 20 nursing students in the fourth semester of the Jahrom University of Medical Sciences were asked to complete the questionnaires, and the reliability of this questionnaire was calculated and confirmed as 0.80 using Cronbach's alpha. The formative assessment score was the average score (out of 100) the students obtained from five instructors during the clerkship period, after performing activities in each ward, answering questions, and participating in group discussions.

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The summative assessment score was also the average score that the students got by participating in the end-of-course OSCE exam. The total OSCE score of the final exam was calculated (out of 100) based on the average scores got from each station. After the clerkship, the educational environment of the pharmacology clerkship was investigated using DREEM (23, 24). This scale comprises 43 items in four domains of the student's understanding of his/her own learning (12 questions), the student's understanding of the professors (11 questions), the student's understanding of his/her academic performance (8 questions), and the student's understanding of the educational environment (12 questions) rated on a scale of 0 (very low) to 4 (very high). The questionnaire score ranged between 0 and 172, and a higher score indicates a better educational quality from the respondent's point of view. According to a study by Fallah et al., the psychometrics evaluation of this questionnaire has been conducted and confirmed in Iran (25).

Data analysis

The obtained data was analyzed using descriptive (mean, standard deviation, and frequency [%]) and inferential statistics (paired t-test and correlation) in SPSS software (version 21). A P-value of 0.05 was considered statistically significant. The data normality was assessed and confirmed using the Kolmogorov-Smirnov test.

Results

In the present study, the mean age and grade point average (GPA) of the students participating in the study were 22.34±1.18 year and 15.24±6.24. Most of the participants (n=16; 53.3%) were female. The results of the paired t-test showed a significant difference in the mean scores of achieving educational goals before and after the intervention (t=-6.36, P<0.001, Table 2). The mean scores of formative (83.66±7.51) and summative (83.26±7.09) assessments were reported out of 100 (Figure 1). In addition, the mean score of the educational environment of the pharmacology clerkship was also reported as 98.5±18.86 out of 170. The mean score of the educational environment of the pharmacology clerkship showed no statistically significant relationship with GPA, age, and gender (Table 3).

Table2. Comparison of the mean scores of achieving the educational goals of pharmacology clerkship students before and after the blended learning

Achieving the educational goals of the clerkship	Mean ± standard deviation		df	t	P- Value*
	Before training	48/43±22/41	29	-6.36	P<0.001
	After training	74.00±14.47			

*Paired Sample T-test ،The significance level is 0.05

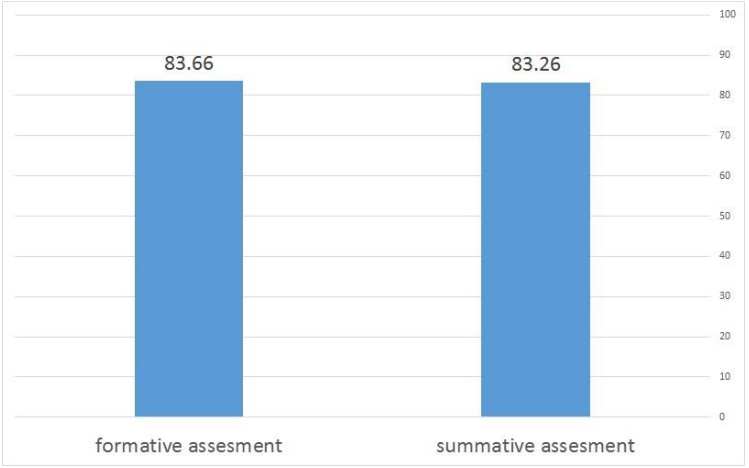


Figure 1. The graph of the mean score of summative and formative evaluation

Table3. Correlation of the average scores of students' opinions about the educational environment of the pharmacology clerkship with the variables of GPA, age and gender

Variable	Gender		Age		GPA	
	r	*P-Value	r	P-Value	r	P-Value
The mean score of the educational environment	0.065	0.734	0.148	0.442	0.078	0.722

*Spearman and Pearson Correlation، The significance level is 0.05

Discussion

This study was conducted to determine the effect of blended learning on the learning level of nursing students in pharmacology clerkship course along with its educational environment. The results of the present study showed a significant difference between the mean scores of achieving educational goals before and after the intervention, as well as an increase in the mean scores of the student. The mean score of the educational clerkship environment was also desirable. In line with the results of the present study, other studies have also shown that blended learning with an emphasis on different aspects of learning among students with different learning strategies can improve learning levels (7, 8). Considering that pharmacology is an important course with a large amount of content and it is difficult to memorize, analyze, and administer medications on time for each patient (26), adopting appropriate instructional methods can improve the learning and performance of students in the clinical environment.

The present study used blended learning based on electronic education, along with conventional methods, to teach the principles and skills of administering medications to the patients in the pharmacology course. It is worth mentioning that favorable results were obtained. Gill et al. in a systematic review found that blended learning, simulation, and electronic education were the most effective ways to improve pharmacology knowledge and increase students' satisfaction (2). Hua et al. compared the conventional teaching method and blended learning in the pharmacology course. They added online learning activities to face-to-face training in blended learning, and two-thirds of the students found this method effective (27).

In the same line, Kayzouri and Sadeghpour investigated the conventional, electronic, and electronic-conventional instruction in learning pharmacology among nursing students. The results revealed that the conventional-electronic education method was successful in improving the students' scores (28). Accordingly, it is suggested that blended learning be used not only in the instruction of theoretical contents of pharmacology but also in the clinical education of the students. It should be noted that the present study utilized the blended learning in the clinical education of students' pharmacology course; however, other studies used this approach in the instruction of theoretical contents. According to the results of the present study and the competencies of this method, it is recommended to use this educational approach for the clinical education of nursing students.

Since the success of students can be influenced by the educational environment, the study of this issue can be a contributing factor in identifying the students' perceptions of the learning environment, creating opportunities for contemplating, developing plans and programs, and combining appropriate educational approaches to improve the educational environment (290). For this purpose, DREEM was used to investigate the impact of new educational interventions and identify the strengths and weaknesses of educational programs (30). Few studies have investigated the educational environment of faculties and the impact of educational interventions on this issue. One strength of the present study is the use of blended learning to investigate the educational environment of the pharmacology clerkship course from the perception of students, which was reported desirable. Most of the students at the Golestan University of Medical Sciences also reported a favorable level of the educational environment at this university (31).

In contrast, in a study performed by Managheb and Rezaeian in 2013 on the nursing students of the Jahrom University of Medical Sciences, the students had negative opinions about their scientific competencies; they stated that the educational environment was scary, which required many modifications (32). The results of a study carried out by Farajpour et al. also showed an average level of nursing students' perception of the educational environment. There were different domains that should be implemented in the educational programs to improve and promote the educational system, followed by applying new instructional and student-

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centered strategies (33). Similarly, the results of a study conducted by Qin et al. showed that the use of novel educational methods can improve the educational environment (34); therefore, blended learning can be effective in the clinical education of pharmacology. Electronic learning helps students take responsibility for their own learning process and enhances their learning experiences. In addition, doing assignments during the semester helps students to be up-to-date and focus on the course progression.

Limitations of the study

Regarding the limitations, one can refer to the single-group design of the study, the small sample size, and the lack of long-term evaluations of the students' learning level. The researchers of the study took the responsibility of being instructors in pharmacology clerkship and OSCE exam, and they could not be replaced since there were no clinical instructors available.

Conclusion

Results showed that the use of blended learning in pharmacology clerkship is a suitable method to achieve the instructional learning goals, which is accompanied by a favorable educational environment from the students' point of view. The results of the present study can be used as a model for applying blended learning in other clerkships for nursing students. The type of educational curriculum design predicts students' learning outcomes and behaviors. Medical education centers have always been looking for methods that are more efficient and effective compared with other educational approaches. It is suggested to use blended learning in other clinical clerkships, followed by evaluating and comparing the results. Future studies are also recommended to employ larger sample sizes, an experimental method, and a long-term learning evaluation.

Ethical considerations

This study was extracted from a research project (IR.JUMS.REC.1394.007). Informed consent was obtained from all the students in the study, and they were assured that their participation in the study had no effects on their evaluation, and the results of the study would be used anonymously.

Conflict of interest

The authors declare no conflict of interest in terms of conducting the study.

Aknowledgement

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