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The effect of simulation education based on flipped learning on academic engagement, motivation, and performance of nursing students: A quasi-experimental study

Background: Simulation education based on flipped learning allows millennial students to adopt a self-directed learning style. This study aimed to determine the effect of simulation education based on flipped learning on academic performance, motivation in learning, and academic engagement of first-year undergraduate nursing students.

Method: This study was conducted with semi-experimental design. 40 undergraduate nursing students at Lorestan University of Medical Sciences was selected by whole enumeration. Teaching was provided conventionally for the control group (n = 18) while simulation education based on flipped learning was done for the intervention group (n = 22). The academic performance of the participants was measured using the observation checklists, also they completed the academic engagement scale and the Instructional Materials Motivation Scale at two points. Data were analyzed using t-test, paired t-test, chi-square, and ANCOVA.

Results: There was no significant statistical difference between the two groups after the intervention in the mean of the performance (F = 2.49, P < 0.09), motivation in learning (F = 0.75, P < 0.48) and academic engagement of nursing students (F = 1.1, P > 0.34).

Conclusions: Using the simulation teaching approach based on flipped learning can be an alternative teaching strategy for conventional simulation teaching. However, more research is needed on this educational approach to be considered a preferred approach.

Keywords: Simulation, Flipped Learning, Academic Performance, Learning Motivation, Academic Engagement, Nursing Students

تأثیر آموزش شبیه‌سازی مبتنی بر رویکرد یادگیری وارونه بر درگیری تحصیلی، انگیزش و عملکرد دانشجویان پرستاری: یک مطالعه نیمه تجربی

زمینه و هدف: آموزش شبیه‌سازی مبتنی بر یادگیری وارونه به دانشجویان نسل جدید اجازه می‌دهد تا سبک یادگیری خودراهر را اتخاذ نمایند. مطالعه حاضر به منظور تعیین تأثیر آموزش شبیه‌سازی مبتنی بر یادگیری وارونه بر عملکرد تحصیلی، انگیزش در یادگیری و درگیری تحصیلی دانشجویان کارشناسی سال اول پرستاری انجام شد.

روش: در این پژوهش نیمه تجربی 40 دانشجوی ترم اول کارشناسی پرستاری در دانشگاه علوم پزشکی لرستان به صورت سرشماری انتخاب شدند. آموزش شبیه‌سازی مبتنی بر یادگیری وارونه برای گروه مداخله (n=22) و آموزش مبتنی بر شبیه‌سازی برای گروه کنترل (n=18) انجام شد. عملکرد تحصیلی شرکت‌کنندگان با استفاده از چک لیست، انگیزش در یادگیری و درگیری تحصیلی با استفاده از پرسشنامه در دو مقطع زمانی اندازه‌گیری شد. داده‌ها با استفاده از آزمون t زوجی، تی مستقل، کای اسکور و آنالیز آنکوا تجزیه و تحلیل شدند.

یافته‌ها: تفاوت آماری معنی داری در میانگین عملکرد (F=2.49, P<0.09)، انگیزش در یادگیری (F=0.75, P<0.48) و درگیری تحصیلی (F=1.1, P>0.34) دانشجویان پرستاری در رویکرد آموزش شبیه‌سازی مبتنی بر یادگیری وارونه در مقایسه با روش مرسوم وجود نداشت.

نتیجه‌گیری: آموزش شبیه‌سازی مبتنی بر یادگیری وارونه می‌تواند یک راهبرد آموزشی جایگزین برای آموزش شبیه‌سازی مرسوم باشد. با این حال، تحقیقات بیشتری در مورد این رویکرد آموزشی مورد نیاز است تا به عنوان یک رویکرد ترجیحی در نظر گرفته شود.

واژه‌های کلیدی: شبیه‌سازی مبتنی بر یادگیری وارونه، عملکرد تحصیلی، انگیزش یادگیری، درگیری تحصیلی، دانشجویان پرستاری

تأثیر التعليم بالمحاكاة القائم على التعلم المقلوب على المشاركة الأكاديمية والدافعية والأداء لدى طلاب التمريض: دراسة شبه تجريبية

الخلفية: يسمح التعليم المحاكاة القائم على التعلم المقلوب للطلاب من جيل الألفية بتبني أسلوب التعلم الموجه ذاتياً. هدفت هذه الدراسة إلى تحديد تأثير تعليم المحاكاة المعتمد على التعلم المقلوب على الأداء الأكاديمي، والدافعية في التعلم، والمشاركة الأكاديمية لطلاب التمريض في السنة الأولى الجامعية.

الطريقة: أجريت هذه الدراسة بالتصميم شبه التجريبي. تم اختيار 40 طالباً من طلاب التمريض الجامعيين في جامعة لورستان للعلوم الطبية عن طريق التعداد الكامل. تم توفير التدريس بشكل تقليدي للمجموعة الضابطة (n = 18) بينما تم إجراء تعليم المحاكاة على أساس التعلم المقلوب لمجموعة التدخل (n = 22). تم قياس الأداء الأكاديمي للمشاركين باستخدام قوائم الملاحظة، كما أكمّلوا مقياس المشاركة الأكاديمية ومقياس الدافعية للمواد التعليمية في نقطتين. تم تحليل البيانات باستخدام اختبار t، واختبار المقترن، ومربع كاي، وANCOVA.

النتائج: لم يكن هناك فروق ذات دلالة إحصائية بين المجموعتين بعد التدخل في متوسط الأداء (F = 2.49, P < 0.09)، الدافع في التعلم (F = 0.75, P < 0.48) والمشاركة الأكاديمية لطلاب التمريض (F = 1.1, P > 0/34).

الاستنتاجات: إن استخدام منهج التدريس بالمحاكاة المبني على التعلم المقلوب يمكن أن يكون استراتيجية تدريس بديلة لتدريس المحاكاة التقليدية. ومع ذلك، هناك حاجة إلى مزيد من البحث حول هذا النهج التعليمي حتى يعتبر النهج المفضل.

الكلمات المفتاحية: المحاكاة، التعلم المقلوب، الأداء الأكاديمي، دافعية التعلم، المشاركة الأكاديمية، طلاب التمريض

نرسنگ طلباء کی تعلیمی مصروفیت، حوصلہ افزائی اور کارکردگی پر پلٹ جانے والی تعلیم پر مبنی نقلی تعلیم کا اثر: ایک نیم تجرباتی مطالعہ

پس منظر: فلیڈ لرننگ پر مبنی نقلی تعلیم ہزار سالہ طالب علموں کو خود ہدایت سیکھنے کا انداز اپنانے کی اجازت دیتی ہے۔ اس مطالعہ کا مقصد تعلیمی کارکردگی، سیکھنے میں حوصلہ افزائی، اور پہلے سال کے انڈرگریجویٹ نرسنگ طلباء کی تعلیمی مصروفیت پر فیلڈ شدہ سیکھنے کی بنیاد پر نقلی تعلیم کے اثر کا تعین کرنا تھا۔

طریقہ: یہ مطالعہ نیم تجرباتی ڈیزائن کے ساتھ کیا گیا تھا۔ لورستان یونیورسٹی آف میڈیکل سائنسز میں 40 انڈرگریجویٹ نرسنگ طلباء کو پوری گنتی کے ذریعے منتخب کیا گیا۔ کنٹرول گروپ (n = 18) کے لیے روایتی طور پر تدریس فراہم کی گئی تھی جب کہ مداخلتی گروپ (n = 22) کے لیے فیلڈ لرننگ پر مبنی نقلی تعلیم دی گئی تھی۔ شرکاء کی تعلیمی کارکردگی کو مشاہداتی چیک لسٹ کا استعمال کرتے ہوئے ماپا گیا، ساتھ ہی انہوں نے تعلیمی مصروفیت کے پیمانے اور تدریسی مواد کی حوصلہ افزائی کے پیمانے کو دو پوائنٹس پر مکمل کیا۔ ڈیٹا کا تجزیہ ٹی ٹیسٹ، پیئرڈ ٹی ٹیسٹ، چی اسکوائر، اور اینکوا کا استعمال کرتے ہوئے کیا گیا۔

نتائج: کارکردگی (F=2.49, P < 0.09)، سیکھنے میں حوصلہ افزائی (F=0.75, P > 0.48) اور نرسنگ طلباء کی تعلیمی مصروفیت میں مداخلت کے بعد دونوں گروپوں کے درمیان کوئی خاص شماریاتی فرق نہیں تھا (F=1.1, P > 0/34)۔

نتیجہ: فیلڈ لرننگ پر مبنی نقلی تدریسی طریقہ کار کا استعمال روایتی نقلی تدریس کے لیے ایک متبادل تدریسی حکمت عملی ہو سکتی ہے۔ تاہم، اس تعلیمی نقطہ نظر پر مزید تحقیق کی ضرورت ہے تاکہ اسے ترجیحی نقطہ نظر سمجھا جائے۔

مطلوبہ الفاظ: تخوین، فیلڈ لرننگ، تعلیمی کارکردگی، سیکھنے کی تحریک، تعلیمی مصروفیت، نرسنگ طلباء

INTRODUCTION

One innovative pedagogical approach is blended or hybrid learning which has steadily replaced traditional teaching methods as an advanced educational strategy (1). One of these hybrid approaches is flipped classroom, with the help of which learning has been rapidly developed and recognized as an acceptable and active approach in education. The flipped classroom creates an ideal combination of online and face to face learning known as the "blended" classroom (2).

The simulation-based education (SBE) is often used to teach nursing skills. However, the same approach is associated with limitations in the problem-solving process, developing clinical application ability, and increasing stress for nursing students. Consequently, a teaching-learning method is required as a new approach to overcome the limitations and problems of the SBE, so that it can further improve the quality of nursing education in the evolving healthcare environment (3). Although professional simulation organizations support pre-simulation activities, little work has been done in the area of simulation on how to motivate students to do preparatory work. It should be combined with the flipped learning model to improve the quality of nursing education (4). However, this combination has not yet been tested quantitatively in a well-designed study (5).

Simulation education based on flipped learning allows millennial students to adopt a self-directed learning style and address their need to access up-to-date information (6). In recent years, many educators have used the flipped classroom approach to facilitate learning, address the various educational needs of students, and increase student engagement (7).

Studies that have been conducted to discover the effect of the flipped classroom on students' academic engagement are almost rare. Busebaia and John (2020) assessed the effects of flipped learning on academic achievement and nursing student's engagement. Participants suggested that further empirical evidence is required for adapting flipped classroom to other courses in the curricula to determine its suitability to a particular teaching content (8). There is also growing evidence that the flipped classroom model is effective in motivating students to carry out preparatory activities. As a result, educators should not fear accepting the flipped model of SBE (9). A systematic review showed that the flipped class improves knowledge level, skills, learner's motivation, and self-directed learning. In addition, according to this systematic review, it is necessary to conduct empirical research with a strong methodology using evaluation criteria to sustain the efficiency of the flipped classroom (10). Gu and Sack (2021) found that SBE with flipped learning is the most effective training method to help nursing students improve their nursing skills, develop basic skills, become self-aware and learn to be satisfied (3). Kim and Jang's also reported the positive effects of the simulation education based on flipped learning on the knowledge and competence of clinical practice, teamwork skills, and the level of satisfaction of students (11). The teaching of clinical nursing skills is one of the important components of the nursing education program. Nursing students learn the basic nursing skills in

this course in the first year of study (12). They should have the ability to use nursing principles and skills in providing care to patients so that they can apply the learned theoretical knowledge in practice (13). Investigating health-related sciences, despite the growing trend to use the flipped teaching model, there is little research and evidence in the curricula of practical courses and clinical nursing skills (14). Most studies were concerned with academic performance and achievement and were mainly used for theoretical courses (15). Flipped learning is an appropriate educational approach to provide nursing students with professional skills and competencies (11). The researchers found that most students had a positive understanding of how to use the desired approach to enhance clinical knowledge and skills. They indicated that this was a more effective approach than the traditional teaching (16). Although some sources have demonstrated the benefits and positive impacts of flipped learning (17,18) others did not show significant differences between simulation based on flipped and traditional learning (19). Therefore, more research is needed to evaluate whether this new approach increases students' learning motivation, academic engagement, and academic performance. Consequently, the purpose of the present study was to determine the effect of simulation education based on flipped classroom learning on motivation, academic engagement, and academic performance of nursing student.

METHODS

The current study is a semi-experimental pre-test-post-test study with a control group. This study was conducted in two nursing schools affiliated with Lorestan University of Medical Sciences in the second semester of 2021-2022. The selection of two groups from two separate colleges was aimed to prevent diffusion and imitation effects between groups.

Participants

Nursing students of the Khorramabad Nursing School (number=22) were selected as the intervention group, and Aligudarz School of Nursing (number=18) was selected as the control group, non-randomly. Students were selected by the whole enumeration and entered based on the study criteria. The inclusion criteria included studying in the first year of a nursing bachelor's degree, willingness to participate in the study, lack of the previous familiarity with the flipped classroom, and enrollment in the fundamental of nursing course. If the students did not want to continue cooperation, they were excluded from the study.

Fundamentals of nursing course

Fundamental of nursing skills is one of the specialized courses of the undergraduate nursing education program for one and a half credits. The outline of this course is presented in Table 1. It should be noted that the course design and planning of the educational process were done with the participation of the teachers of both faculties according to the ADDIIE model (Figure 1).

Intervention

According to the teaching approach, during the first six weeks of the academic semester, the students of the intervention group were taught by low-fidelity SBE method (traditionally) in comparison to the control group (Skill Lab

mannequins were used to teach this category of psychomotor skills, mainly, the training by the instructor was in the form of a lecture with a practical demonstration of the mannequin). The instructor conducted the second six weeks in the intervention group the simulation education based on flipped learning method. In the control group, all sessions (from the first to the end of the 12th session) were taught by the same instructor using the SBE method.

Intervention group

Simulation education based on flipped learning for six other skills (Table 1) was conducted in the second six weeks of the academic semester for the intervention group in the form of a three-step process, which is explained below:

1. Pre-class activities

The video and text content was pre-designed by the

instructors. One week before the presentation of each psychomotor skill, its educational content was provided to the participants in the form of PowerPoint files and short videos through LMS (learning management system). The content-sharing platform was the LMS of Iran Virtual University of Medical Sciences. Students could easily view the content uploaded in this system through their computer or mobile phone. Students studied educational content and videos at home. In order to ensure the viewing of the procedure video of each session, the trainers reminded their expectations about the need to prepare before the class and watch the videos every session.

2. In-class activities

This stage focused on peer activities and discussions with the instructor. During the flipped classroom session, students

Table 1. Topic list and content of the fundamentals of nursing course for weekly sessions		
Sessions	Content of simulation based education	Content of simulation education based on flipped learning
First	Medical and surgical hand washing	Dry and sterile dressing
Second	Wearing a gown, mask and sterile gloves	Placement of nasogastric tube and gavage
Third	Control and recording of vital signs	Principles of administering injectable drugs
Fourth	Principles of prescribing non-injectable drugs	Oxygen therapy
Fifth	Fluid therapy	Nasopharyngeal suction
Sixth	Urinary catheterization	Enema

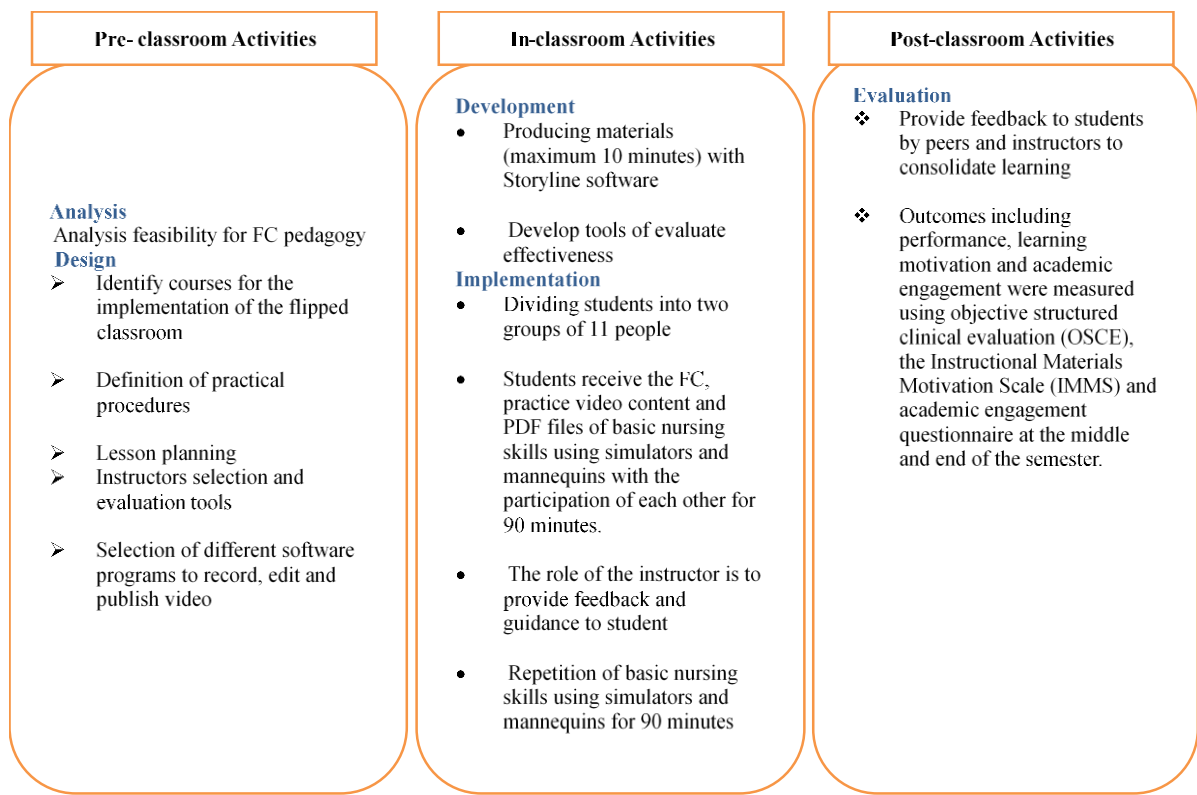


Figure 1. Steps of the flipped classroom model

were divided into two groups. Each group consisted of 11 students and a clinical instructor. Two instructors taught the groups equally. In each group, before starting each session, they explained a short introduction for 10 minutes about the general and specific goals of the lesson. Then, the students practiced and explained the video content and PDF files of basic nursing skills using mannequins with the participation of each other for 90 minutes. The teacher mostly listened. If needed, he would answer their questions and clarify the concepts. The teacher's role was to provide feedback during the exercise. Students discussed the main points of the videos.

3. Post-class activities

Finally, after a 20-minute break and the end of the class, the students practiced the same skill again using a mannequin for another 90 minutes to consolidate learning by providing feedback from peers and teachers. The learners were asked to note down the critical points of the procedure.

Control group

In the control group, all sessions (from the first to the end of the 12th session) were taught by using the SBE method. If the students had questions, they would be asked during the training, and the instructor would give feedback. In this way, the instructor had an active role, and the student had a passive role.

Instruments

Four tools were used in this study. Evaluation of this educational method's effectiveness was based on Kirkpatrick's pyramid in two levels: reaction and learning. At the first level of the model, learners' motivation was evaluated with the Instructional Materials Motivation Scale (IMMS). The next level of the model was the student's performance, which was assessed via an objective structured clinical test (OSCE) and checklists related to each station. In addition to the above tools, a demographic form and an academic engagement scale were also used.

Tool I: Questionnaire of demographic characteristics

This tool was used to obtain data regarding age, gender, economic status, living situation, their high school grade-point average (GPA) scale ranging from 0 to 20, occupation and education of parents.

Tool II: (IMMS)

IMMS was used to evaluate learning motivation. This tool has 36 items and four subscales, including attention, communication, confidence and satisfaction. It is answered on a 5-point Likert scale. Ten items are reverse. In the reverse items, lower scores indicate higher motivational levels. The score is calculated for each subscale as well as the whole scale (total score). The minimum and maximum total scores are 36 and 180. A higher score indicates a higher motivation to learn. In a study, the instrument's internal consistency has been confirmed with Cronbach's alpha (0.95) (20). In a study in Iran, the reliability of this tool has been established with Cronbach's alpha (0.82) (21).

Tool III: Academic Engagement Scale

This scale has 22 items and four components, including behavioral involvement, agent involvement, cognitive involvement, and emotional involvement. It is based on a five-point scale from always (5) to never (1). The range of

scores for each subject is between 22 and 110. The reliability and validity of this tool were reported by Reeve and Tseng (2011) as high and acceptable (22). In Iran, the reliability of the total scale instrument has been reached using Cronbach's alpha of 0.87 (23). In this study, Cronbach's alpha of the tool was confirmed from 0.70 to 0.78.

Tool IV: Fundamentals of nursing skills and observation checklists

The learners' performance was also evaluated with a checklist. The validity of these checklists has been confirmed in a previous study (24). Each measurement checklist included items related to each basic nursing skill that measured skill accuracy using a 3-point Likert scale (0 = not performed, 1 = partially performed, 2 = fully performed).

Data collection

The variables were measured at two-time points, the end of the sixth session (pre-test) and the end of the 12th session (post-test), by completing the academic engagement scale and the IMMS by the participants remotely and by sending a link through WhatsApp social messenger. Also, the student's performance at two-time points, including the mid-semester and end-semester tests, was measured by the observation method using a checklist.

Data analysis

Descriptive statistics were used to describe demographic data, including mean, standard deviation, frequency, and percentage. The Kolmogorov-Smirnov test was used to ensure the normality of data distribution. An Independent t-test was used to compare the difference between the mean performance scores, learning motivation, and academic engagement of students between two groups. A paired t-test was used to compare students' mean performance scores, learning motivation, and academic engagement in the before and after measurements separately for each group. Also, the analysis of covariance test was used to compare the mean of quantitative variables in the next phase between two groups and adjust the effect of the previous phase. The Chi-square test was used to examine the relationship between qualitative variables. All analyzes were performed using Stata 17 software. The significance level for all tests was 5 percent.

RESULTS

Demographic data of the experimental and control groups were analyzed using chi-square and two-tailed t-tests. The results showed no statistically significant difference between all demographic variables in both groups. Both groups were the same regarding age, gender, economic status, living situation, their high school GPA, occupation and education of parents (Table 2) ($P > 0.05$).

The mean score of students' academic performance (of 0-20 scores) in the intervention group in the first six weeks and the second six weeks after simulation education based on flipped learning was 14.52 ± 3.12 , 15.52 ± 2.55 , respectively. The student's performance in the control group was 15.38 ± 3.35 and 16.88 ± 1.77 in the first six weeks and the second six weeks, respectively. The paired t-test did not show a statistically significant difference between the two groups.

The mean total score of motivation in learning and its

Table 2. Demographics of the participants (N=40)

Characteristic	Flipped Learning N (%)	Control N (%)	P value
Sex	Male	11(50)	1
	Female	11(50)	
Economic status	Good	4(18)	0.9
	Average	18(82)	
Living status	With family	9(41)	0.8
	Dormitory	13(59)	
Father's level of education	Diploma	5 (23)	0.99
	High school	14 (64)	
	Higher than diploma	3 (13)	
Father's job	Unemployed	0	0.91
	Employee	7 (32)	
	freelance job	15 (68)	
Mother's education level	Diploma	5 (23)	0.88
	High school	14 (64)	
	Higher than diploma	3 (13)	
Mother's job	Employee	3 (14)	0.78
	Unemployed	19 (86)	
Age	20.04 (2.43)	20.27 (2.63)	0.77
GPA	18.50 (0.99)	18.46(1.04)	0.89

Table 3. Comparisons of the total and subscales scores of IMMS between two groups

Variables		Intervention Group (n = 22) Mean± SD	Paired t-test	P value	Control Group (n= 18) Mean± SD	P value	Paired t-test
Attention	Pre	39.95 (4.79)	0.55	0.58	40.66 (4.57)	0.80	0.24
	Post	39.31 (4.23)			40.33 (3.75)		
Relevance	Pre	32.54 (4.13)	0.82	0.41	34.27 (4.07)	0.91	0.11
	Post	31.59 (5.09)			34.11 (3.75)		
Confidence	Pre	30.77 (4.80)	0.47	0.64	30.61(6.12)	0.76	0.3
	Post	30 (6.78)			29.94 (6.14)		
Satisfaction	Pre	22.22 (4.01)	0.35	0.72	25.11 (4.57)	0.83	0.2
	Post	21.72 (5.62)			24.72 (4.46)		
Total IMMS	Pre	125.5 (14.68)	0.6	0.51	130.66 (16.51)	0.79	0.2
	post	122.63 (18.29)			129.11(14.20)		

subscales in two groups in the first six weeks and the second six weeks are presented in Table 3. The paired t-test did not show any significant difference between the two groups in the total score of learning motivation and all sub-scales. Also, according to Table 4 and the paired t-test, there was no significant difference between the two groups regarding the total score of academic engagement and its subscales. The analysis of covariance test was used to compare the mean of the performance ($P>0.09$), motivation in learning ($P>0.48$), and academic engagement ($P>0.34$) of students

after the intervention between two groups to adjust the effect of the previous phase, which did not show any significant difference between the two groups.

DISCUSSION

This study showed no difference between students' academic performance in the simulation approach based on the flipped classroom and the simulation in a conventional way. Similarly, Wilson and Hobbs (2022) found that nursing students' validation scores using the flipped classroom

Table 4. Comparisons of the total and subscales scores of engagement between two groups

Variables		Intervention Group (n = 22) Mean±SD	Paired t-test	P value	Control Group (N= 18) Mean±SD	Paired t-test	P value
Agetic	Pre	16.5 (5.8)	-0.12	0.90	16.44(3.9)	-0.52	0.60
	Post	16.68 (3.77)			17.05 (3.63)		
Behavioral	Pre	19.95 (3.55)	0.96	0.34	20.77 (3.19)	0.17	0.86
	Post	19.09 (3.30)			20.61 (3.36)		
Emotional	Pre	16 (2.63)	0.98	0.33	16.88 (2.58)	0.98	0.33
	Post	15.13 (3.12)			16.22 (2.31)		
Cognitive	Pre	30.59 (4.7)			31(3.59)		
	Post	28.27 (4.91)			30.55 (4.73)		
Total engagement	Pre	83.04 (13.61)	1.02	0.31	85.11(11.55) 0.18	0.18	0.85
	Post	79.18 (12.85)			84.44 (12.06)		

approach in the fundamental nursing course were not different using a flipped-classroom approach compared to in-person instruction (24). The meta-analysis by Gillette et al (2018) did not show a significant difference in academic performance test scores between the flipped and traditional classrooms (25). Instructors and students have noted problems with this interactive learning strategy. Students should prepare for the flipped class. Some students still resist being active in class and outside of it (26). In contrast, other studies have shown that the flipped learning approach has made significant progress in the academic performance of nursing students (10, 11).

These differences in the results can be attributed to different processes, materials, and environments used in using the flipped learning model. The difference between this models in the academic performance of students is due to the use of different materials in various lessons. The types of materials used and the learning environment can affect academic performance success. In addition, the educators who manage this process plan it in different ways and perform various classroom activities. These differences in activities may have produced mixed results.

On the other hand, the students in this study (who were in the first semester) had never experienced the simulation method and the flipped classroom in their learning history. These students needed more time to get used to the new method, which may have affected the results of the present study. Changing the traditional teaching method suddenly harms their learning outcome due to insufficient preparation of students with the new teaching method (27). Therefore, such methods that allow students to take more active roles and positively affect the learning outcome should be included in future educational programs to enable students to move from passive to interactive learning methods.

A systematic review showed that flipped classrooms might only suit some subjects, teachers, or learners. Choosing a course for flipped learning is an important decision and requires careful assessment of learners' expectations and needs before designing a flipped class. Hence, if educators carefully consider content, materials, presentation, and

designs, they can create a flipped classroom course that supports students in acquiring conceptual knowledge and higher-order thinking skills and may produce better outcomes (28).

The present study showed that the construct of learning motivation in the flipped simulation strategy did not increase significantly compared to the simulation classroom performed conventionally. However, more motivation is needed in the flipped classroom for participation in discussions and completion of extracurricular activities. Some students prefer the flipped classroom over the traditional classroom, possibly because of the effort and participation required in active learning (29). The issue is that even though the students in Luo and Hugh's study preferred the flipped classroom to the traditional classrooms, the student's motivation and academic involvement in solving the problems were successfully improved (30). On the other hand, the results of a meta-analysis of 271 studies have identified challenges for students and teachers. Students' challenges included a need for more motivation to watch pre-recorded videos. For teachers, the challenges included the need for more preparation, difficulty controlling students' pre-class activities, and technical challenges involving technological problems and internet access (31). In the meantime, the most critical challenge for teachers was the need for students' motivation to watch pre-recorded video lectures or study content outside the classroom (32).

A positive factor of the flipped classroom approach is the use of active learning methods that provide many learning opportunities in the classroom. Another positive factor is the increase in interaction between students and lecturers. However, a negative factor is that students tend to explain more passively. Probably because students sometimes need help to acquire lower-level skills during out-of-class activities when the structures are new or difficult to understand (33). The results of this study did not show a difference in the levels of academic engagement between the two approaches. This result is in line with the study of Subramaniam and Muniandi, who investigated the academic engagement levels

of computer science students using the inverted classroom approach. The results indicated that the students of the experimental group (inverted classroom) were very involved. However, compared to the didactic class, there was little difference in academic involvement in the flipped classroom (34). A literature review suggests that participants in the flipped classroom are more active and engaged than in traditional education. They show more behavioral and emotional involvement. As a result, they prepare themselves to participate in class activities, ask questions, and solve problems with their peers. The main reason for students' academic engagement was their pre-learning activities in and out of class (33, 35).

On the other hand, changing education can cause confusion and stress among students and teachers. Teachers are very comfortable with traditional education as information holders, but they must work hard to change their classes to teach students independent learning. At the same time, some students who have been very comfortable with conventional instruction may need to be more enthusiastically engaged in independent study, especially outside of classroom hours. They are not ready to learn independently outside the classroom without instructor guidance because the content usually presented through lectures is distributed as homework for students to master before attending the classroom (30). However, nursing instructors and students can use these methods. In addition, instructors can develop programs (especially programs that activate students) to identify and use appropriate instructional strategies that match students' learning styles.

Limitations: The study's sample size was small, so it is recommended to conduct further studies with a larger sample size as a clinical trial with a more extended period in the future. Evaluation of outcomes such as motivation and the academic engagement in this study was done using self-report, while future studies should investigate how to objectively evaluate the competence of the essential skills of

nursing students. Also, considering the importance of metacognitive skills and comprehensive self-direction, it is recommended for upper-year students to be used.

CONCLUSION

This study showed that a simulation-based on flipped learning in the fundamental nursing skills course compared to conventional simulation did not show any difference in academic performance, learning motivation, and academic engagement of students. However, more research is needed on this educational approach to be considered a preferred approach. Teaching, fundamentals of nursing skills using the simulation teaching approach based on flipped learning can be an alternative teaching strategy for conventional simulation teaching. However, the potential for implementation of flipped classroom is considerable, although validated methods and evaluation tools are needed, as well as further educational platforms, technologies, learning strategies, and proven practices, to guide educators who intend to change the traditional method to flipped classroom, and provide a reference for flipped classroom researchers in the future.

Ethical consideration

Ethical issues including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors. The Ethics Committee of Lorestan University of Medical Sciences approved this study (IR.LUMS.REC.1401.200).

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