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Comparison between the effect of flipped classroom teaching and traditional classroom teaching in learning and satisfaction of students in microbiology course

Background: The flipped classroom is an alternative educational approach that emphasizes the student-centered teaching method. The purpose of this research was to compare the flipped classroom (FC) teaching method with the traditional classroom (TC) teaching method on the learning and satisfaction of students Aja University of Medical Sciences in the microbiology course.

Method: This interventional study was conducted in 2022 at the paramedical faculty of the Army University of Medical Sciences. The participants in the study were surgical technician students. Evaluation of students' learning was done using MCQ test (pre-test and post-test). The level of satisfaction was measured through a 5-point Likert questionnaire made by the researcher. Data were analyzed with SPSS version 19 software.

Results: The results of the study showed that there was a significant difference between the average learning of the intervention group, $FC=0.82 \pm 9.30$, and the average learning of the comparison group, $TC=3.96 \pm 1.39$. ($P=0.0001$). Also, there was a significant difference between the scores of the satisfaction level of the students of the FC group $=4.69 \pm 0.358$ and the average scores of the comparison group $TC=2.530 \pm 0.863$. ($P<0.05$).

Conclusion: The results of the research showed that teaching using the flipped classroom method in the microbiology course of the surgical technician students increased the learning and satisfaction of the students compared to the traditional teaching method.

Keywords: Flipped classroom, Reverse teaching, Traditional classroom, Traditional teaching, Lecture, Satisfaction, Learning

مقایسه بین تأثیر تدریس در الفصول المقلوبه والتدریس فی الفصول التقليدية فی التعلیم ورضا الطلاب فی مقرر علم الأحياء الدقيقة

الخلفية: إن الفصل المقلوب هو أسلوب تعليمي يبدل يركز على أسلوب التدریس الذي يركز على الطالب. كان الغرض من هذا البحث هو مقارنة طريقة التدریس بالفصل المقلوب (FC) مع طريقة التدریس بالفصل الدراسي التقليدي (TC) على التعلیم ورضا طلاب جامعة أجا للعلوم الطبية في مقرر علم الأحياء الدقيقة. **الطريقة:** أجريت هذه الدراسة التداخلية في عام ٢٠٢٢ في كلية الطب بالجامعة العسكرية للعلوم الطبية. المشاركون في الدراسة كانوا طلاب فنيين جراحيين. تم تقييم تعلم الطلاب باستخدام اختبار MCQ (الاختبار القبلي والاختبار البعدي). وتم قياس مستوى الرضا من خلال استبيان ليكرت المكون من ٥ نقاط والذي أعدته الباحثة. تم تحليل البيانات باستخدام برنامج SPSS الإصدار ١٩.

النتائج: أظهرت نتائج الدراسة وجود فرق كبير بين متوسط التعلیم لمجموعة التدخل، $FC=0.82 \pm 9.30$ ، ومتوسط التعلیم لمجموعة المقارنة، $TC=2.530 \pm 0.863$. ($P<0.05$). كما كان هناك فرق كبير بين درجات مستوى رضا طلاب مجموعة $FC=4.69 \pm 0.358$ ومتوسط درجات مجموعة المقارنة $TC=2.530 \pm 0.863$.

الاستنتاج: أظهرت نتائج البحث أن التدریس باستخدام طريقة الفصل المقلوب في مقرر الأحياء الدقيقة لطلبة فني الجراحة أدى إلى زيادة التعلیم والرضا لدى الطلاب مقارنة بطريقة التدریس التقليدية. **الكلمات المفتاحية:** الفصل المقلوب، التدریس العكسي، الفصل التقليدي، التدریس التقليدي، المحاضرة، الرضا، التعلیم

مقایسه تأثیر تدریس کلاس وارونه با تدریس به روش سنتی در یادگیری و رضایت دانشجویان در درس میکروبیولوژی

زمینه و هدف: کلاس وارونه یک رویکرد آموزشی جایگزین است که بر روش تدریس دانشجو محور تأکید دارد. هدف این پژوهش، مقایسه تدریس به روش کلاس وارونه (FC) با روش تدریس کلاس درس سنتی (TC) بر میزان یادگیری و رضایت دانشجویان دانشگاه علوم پزشکی آجا در درس میکروبیولوژی بود.

روش: این مطالعه مداخله‌ای در سال ١٤٠١ در دانشکده پیراپزشکی دانشگاه علوم پزشکی ارتش انجام شد. شرکت کنندگان در این مطالعه دانشجویان رشته اتاق عمل بودند. ارزشیابی یادگیری دانشجویان با استفاده از آزمون چندگزینه‌ای (پیش آزمون و پس آزمون) انجام شد. میزان رضایت از طریق پرسشنامه لیكرت ٥ امتیازی ساخته سنجیده شد. داده ها با نرم افزار SPSS نسخه ١٩ تجزیه و تحلیل شد.

یافته ها: نتایج مطالعه نشان داد که بین میانگین یادگیری گروه مداخله $FC=9.30 \pm 0.82$ ، و میانگین یادگیری گروه مقایسه $TC=3.96 \pm 1.39$ تفاوت معنی داری وجود داشت ($P\text{-Value}=0.0001$). همچنین بین نمرات سطح رضایت دانشجویان گروه $FC=4.69 \pm 0.358$ و میانگین نمرات گروه مقایسه $TC=2.530 \pm 0.863$ تفاوت معنی دار وجود داشت ($P\text{-Value}<0.05$).

نتیجه گیری: نتایج پژوهش نشان داد که آموزش با استفاده از روش کلاس‌های وارونه در درس میکروبیولوژی دانشجویان رشته اتاق عمل باعث افزایش یادگیری و رضایت دانشجویان نسبت به روش تدریس سنتی شده است.

واژه‌های کلیدی: کلاس وارونه، تدریس وارونه، کلاس سنتی، تدریس سنتی، سخنرانی، رضایت، یادگیری

ماتیکرو بایولوجی کورس میں طلباء کے سیکھنے اور اطمینان میں فلپ شدہ کلاس روم ٹیچنگ اور روایتی کلاس روم ٹیچنگ کے اثر کے درمیان موازنہ

پس منظر: فلپ شدہ کلاس روم ایک متبادل تعلیمی نقطہ نظر ہے جو طلباء کے مرکز تدریسی طریقہ پر زور دیتا ہے۔ اس تحقیق کا مقصد ماتیکرو بایولوجی کورس میں آجا یونیورسٹی آف میڈیکل سائنسز کے طلباء کے سیکھنے اور اطمینان پر روایتی کلاس روم (TC) تدریسی طریقہ سے فلپ شدہ کلاس روم (FC) کے تدریسی طریقہ کا موازنہ کرنا تھا۔

طریقہ: یہ مداخلتی مطالعہ ٢٠٢٢ میں آرمی یونیورسٹی آف میڈیکل سائنسز کی پیرا میڈیکل فیکلٹی میں کیا گیا تھا۔ مطالعہ میں حصہ لینے والے سرجیکل ٹیکنیشن کے طالب علم تھے۔ طلباء کے سیکھنے کا اندازہ MCQ ٹیسٹ (پری ٹیسٹ اور پوسٹ ٹیسٹ) کا استعمال کرتے ہوئے کیا گیا تھا۔ اطمینان کی سطح کو محقق کے ذریعہ بنائے گئے ٥ نکاتی لیكرت سوالنامے کے ذریعے ماپا گیا۔ ڈیٹا کا تجزیہ SPSS ورژن ١٩ سافٹ ویئر کے ساتھ کیا گیا۔

نتائج: مطالعہ کے نتائج سے پتہ چلتا ہے کہ مداخلت کرنے والے گروپ کی اوسط سیکھنے کے درمیان ایک اہم فرق تھا، $FC=0.82 \pm 9.30$ ، اور موازنہ گروپ کی اوسط سیکھنے میں، $TC=3.96 \pm 1.39$ ($P=0.0001$)۔ نیز، FC گروپ = 4.69 ± 0.358 ، TC = 2.530 ± 0.863 کے اوسط اسکور کے درمیان ایک اہم فرق تھا۔ ($P<0.05$)۔

نتیجہ: تحقیق کے نتائج سے پتہ چلتا ہے کہ سرجیکل ٹیکنیشن طلباء کے ماتیکرو بایولوجی کورس میں فلپ شدہ کلاس روم کے طریقہ کار کو استعمال کرتے ہوئے تدریس نے روایتی طریقہ تدریس کے مقابلے طلباء کے سیکھنے اور اطمینان میں اضافہ کیا۔

مطلوبہ الفاظ: فلپ شدہ کلاس روم، رورس ٹیچنگ، روایتی کلاس روم، روایتی تدریس، لیكچر، اطمینان، سیکھنا

INTRODUCTION

In recent years, the FC has received much attention. The FC is an effective teaching model and method for medical education that has been increasingly used (1,2). Most of the articles published in the field of medical education emphasize that in FC education, the basis of the educational activity is learning, while in the usual educational methods, it is based on teaching and learning (3).

The most effective approach to improve teaching effectiveness is to promote active learning, which requires learners to actively participate in class and collaborate with other classmates (4,5). The FC plays a role in the development of problem solving skills, creative and critical thinking and teamwork in learners (6). Chen et al.'s systematic review pointed out the positive effect of the FC on the participation and motivation of learners (1).

In the FC model, students listen to podcasts or watch recorded lectures before attending class and use class time for student-centered learning activities (2). Unlimited access to teacher content and teaching materials in the FC in the form of pre-recorded video lectures before class, enable students to learn at their own pace, anywhere, anytime (7). In the FC, lectures are replaced by pre-class activities, usually watching online videos, and class time is devoted to interactive activities and discussions. FC enables students to learn outside the classroom and promotes active learning and engagement within the classroom. FC allows students to access recorded lectures and other materials as often as they want and use class time to interact and apply the content (8). The stages of the implementation of the FC include: 1. reverse learning design for planning learning activities, 2. Creating opportunities for pre-study (such as a short film or educational materials, 3. diagnostic and supplementary evaluation to determine learning needs and 4. Use of active learning strategies and technology to respond to learning needs to develop competencies (9).

Considering that traditional learning focuses more on memorization and students are passive in the classroom, therefore, one of the main problems of traditional classroom

(TC) teaching method, including lectures, is the lack of training for self-directed learners and deep learning. The purpose of this research was to compare TC with FC in the learning and satisfaction in the microbiology course of surgical technician students and medical students at Aja University of Medical Sciences.

METHODS

Study design

The cross-sectional descriptive interventional (quasi-experimental) was conducted in 2022 at the Aja university of medical sciences. Surgical technician students were divided into two groups of 23 participants, including FC (intervention group) and TC (control group). The educational subjects selected for the FC group and the TC group were similar in terms of content difficulty. Pierce and Fox (2012) method was used for the basic implementation of the FC intervention (10). Based on this method, the steps of the implementation process after the initial preparation include 1- designing the course, in which the topics that should be taught during the course were determined, 2- content production: slides or short films and podcasts of educational materials were prepared by the teacher, 3- performing initial evaluation: the pre-test was taken from the educational content that was supposed to be provided to the students, 4- presenting the content to the learner: a few days before the formation of the upside-down class, the content was provided to the students so that they have the opportunity to study, 5- homework design: students' homework to be done in the classroom was designed by the teacher both individually and in groups, 6-discussion: at this stage, the students were given the assignments designed in the class, and individually or in groups the students had to present material, question and answer, and discuss about the educational content, 7- mentoring: as a mentor and guide, the teacher solved their needs and mistakes and gave them the necessary feedback, 8- evaluation phase: at the end, in order to evaluate the learning rate of educational materials, a post-test was taken from the students. The steps of the flipped classroom are shown in Figure 1.

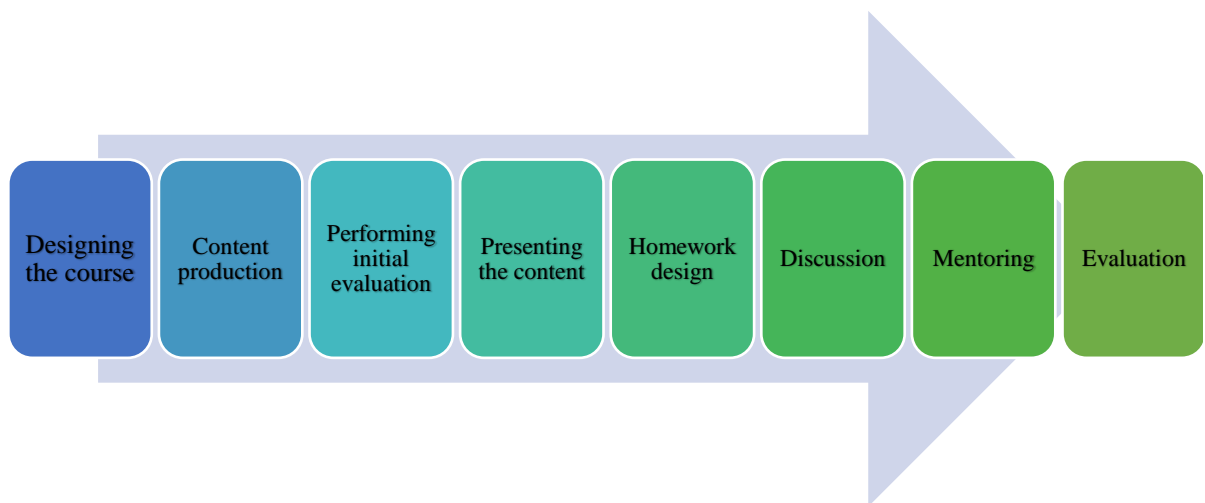


Figure 1. The steps of the flipped classroom

Data collection tool

In this research, a questionnaire tool was used to collect data. multiple choice tests with 10 questions were used to check learning (maximum 10, minimum) and to check the satisfaction of students, a satisfaction questionnaire based on a 5-point Likert scale was used (maximum 5, minimum 1). The validity of the content of the questions has been confirmed by the opinion of several experts and the reliability of the tool has been confirmed by Cronbach's alpha method.

Statistical analysis

Descriptive and inferential statistical tests (Kolmogorov Smirnov test, Wilcoxon test) were performed by SPSS V.19 software. To determine the desirability range of the satisfaction questionnaire, the range of numbers 1 to 5 (Likert scale) was divided into three equal parts. The average between 1 and 2.33, (unsatisfied), between 2.34 and 3.66, (relatively satisfied) and the average between 3.67 and 5, (completely satisfied).

In order to comply with ethics in this work, the purpose of this educational activity and the innovative teaching method (FC method) were explained to the students before starting the work, and they were assured that the results of the study will be reported in the form of keeping the names of the students confidential, as well as the scores of the learning tests. It had no effect on the final grade of the students in the studied course.

RESULTS

The mean pre-test and post-test learning were shown in the microbiology course in two groups of TC (comparison group) and FC teaching (intervention group) were shown in Table 1.

The results of the Wilcoxon test showed that there was a significant difference between the pre-test and post-test learning scores of TC group students at the level of 0.05 (P-

Table1. Mean ±Standard deviation of learning			
Test	TC* comparison group	FC** intervention group	P value
Pre-test	1.95±1.11	3.78±1.24	0.0001
Post-test	3.96±1.39	9.30±0.82	0.0001
P value	0.0001	0.0001	

TC*: Traditional Classroom FC**: Flipped Classroom

Table2. Mean ±Standard deviation of satisfaction	
Group	Mean ±SD
TC	2.530±0.863
FC	4.69±0.358
P-Value	0.0001

Value=0.0001). Also, there was a significant difference between the learning scores in the pre-test and post-test of the students in the FC group (P-Value=0.0001). There was a significant difference between the post-test scores of TC group and FC group (P-Value=0.0001). The results of the Wilcoxon test showed that there was a significant difference between the mean satisfaction of students the TC group and the FC group (P-Value<0.05). (Table 2).

DISCUSSION

The results of this study showed that mean learning of surgical technician students in the microbiology course of Paramedicine Faculty of Aja University of Medical Sciences, in the FC (intervention group) was higher than the TC group (Comparison group). The result of this study indicated the flipped classroom teaching method was more effective compared to traditional teaching method (lecture) in the learning of surgical technician students. In line with this study, the findings of Anjadi et al. (2019) also confirmed the significant difference between the scores of the flipped classroom and the traditional classroom (11). The results of He et al.'s study showed that in the comparison between the flipped classroom and the traditional teaching method, students and professors are more satisfied with the flipped classroom and the grades are surprisingly higher than the traditional method (12).

Contrary to the results of this study, some researchers reported the lack of effect of the flipped classroom approach. Whillier's study (2015) showed that there is no significant difference between the learning of students in the course of nerve anatomy in two groups (traditional, Flipped classroom) (13). The success of the flipped classroom is related to the active learning level of students in the classroom. It is necessary to use cooperative and interactive activities such as small groups, case discussions, and interaction with peers in the classroom (14).

The Flipped method is a student-centered method that includes participation and plays a greater role in the educational process than the professor-centered lecture method (15). This teaching style is an educational strategy and a kind of blended learning that is associated with presenting problem-based assignments to students, and its purpose is to increase students' interaction and learning (16). The condition of success in the flipped classroom teaching method is that the students are prepared to do classroom activities, outside and before the classroom. If this does not happen, the teacher cannot involve them in the classroom activities. The most important way to prepare students is to do homework before class. Doing homework before class instead of continuing the class makes students feel more purposeful in their home activities. Homework is a useful tool for practicing the learned skills, depicting the level of understanding of the course material, monitoring the learning process of the learner and providing appropriate feedback to the learner and the teacher during the learning process. Flores et al. have stated that in FC method, the lesson content is presented outside the classroom and class time is saved. If it is not managed, we face a lack of time to deal with and give feedback to the learners for their

meaningful learning. This issue is especially important if the number of learners in the classroom is large, because maintaining justice in the educational interactions between the teacher and the learners requires time management. Therefore, time and its management play an important role in the success and effectiveness of this teaching method (17). One of the success factors in the implementation of the upside-down classroom is the teacher's skill in using information technology and having knowledge in the field of blended learning and using appropriate content in the virtual space. In this regard, Mohammadimehr (2021) stated that one of the supporting components of students in combined education is the support of professors in the sense of developing the technical skills of professors (18).

In this study, students were more satisfied with the flipped teaching method than the traditional teaching method (lecture). In line with these results, Lin et al.'s study showed that students and professors were more satisfied with the flipped classroom than the traditional classroom (7). The results of other studies indicated the high level of satisfaction of learners with the flipped classroom model (19-21). The limitation of the present study can be stated that this study was limited to the second semester undergraduate students of the operating room in a faculty. Similar studies can be conducted for different academic years and in different medical faculties in a wider volume of study participants.

CONCLUSION

The results of this study showed that FC teaching can be an effective method in surgical technician students. Based on

the results of this study, the FC teaching method was associated with an increase in students' satisfaction compared to the traditional lecture method. Teaching in the FC method increases the active participation of learners in the learning process, and their abilities and capacities come with the help of the teacher's knowledge and skills to make learning more effective. The faculty member must have the motivation and ability to conduct the class correctly and accurately in order to lead to effective learning in the students. Considering the limitations of this study, it seems that more studies with different designs and in different learning situations and students of other degrees and fields of study can make the impact of this method on different aspects of learning clearer.

Ethical Considerations: 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. This study was approved by Aja University of Medical sciences with the ethical code No. IR.AJAUMS.REC.1401.059

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REFERENCES

- Chen F, Lui AM, Martinelli SM. A systematic review of the effectiveness of flipped classrooms in medical education. *Med Educ*. 2017;51(6):585-97.
- Prober CG, Heath C. Lecture halls without lectures—a proposal for medical education. *The New England journal of medicine*. 2012; 366(18):1657-9.
- Tang F, Chen C, Zhu Y, Zuo C, Zhong Y, Wang N, et al. Comparison between flipped classroom and lecture-based classroom in ophthalmology clerkship. *Med Educ Online*. 017;22(1):1395679.
- Freeman S, Eddy SL, McDonough M, Smith MK, Okoroafor N, Jordt H, et al. Active learning increases student performance in science, engineering, and mathematics. *Proc Natl Acad Sci U S A*. 2014;111(23):8410-5.
- Mehta NB, Hull AL, Young JB, Stoller JK. Just imagine: new paradigms for medical education. *Acad Med*. 2013;88(10):1418-23.
- Lin Y, Zhu Y, Chen C, Wang W, Chen T, Li T, et al. Facing the challenges in ophthalmology clerkship teaching: Is flipped classroom the answer? *PLoS One*. 2017 6;12(4): e0174829
- Giuliano CA, Moser LR. Evaluation of a Flipped Drug Literature Evaluation Course. *Am J Pharm Educ*. 2016;80(4):66.
- Sajid M, Shaikh AA, Ikram MF, Cahusac P, Yaqinuddin A, Alkattan W, et al. Comparative Analysis of Effectiveness Between Flipped Classroom and Lecture-Based Classroom in Undergraduate Medical Education at AlFaisal University. *Cureus*. 2020;12(11): e11408.
- Hurtubise L, Hall E, Sheridan L, Han H. The Flipped Classroom in Medical Education: Engaging Students to Build Competency. *J Med Educ Curric Dev*. 2015;2: JMECD.S23895.
- Pierce R, Fox J. Vodcasts and active-learning exercises in a "flipped classroom" model of a renal pharmacotherapy module. *Am J Pharm Educ*. 2012;76(10):196.
- Angadi NB, Kavi A, Shetty K, Hashilkar NK. Effectiveness of flipped classroom as a teaching-learning method among undergraduate medical students - An interventional study. *J Educ Health Promot*. 2019; 8:211.
- He Y, Lu J, Huang H, He S, Ma N, Sha Z, et al. The effects of flipped classrooms on undergraduate pharmaceutical marketing learning: A clustered randomized controlled study. *PLoS One* 2019; 14 (4): e0214624.
- Whillier S, Lystad RP. No differences in grades or level of satisfaction in a flipped classroom for neuroanatomy. *J Chiropr Educ*. 2015;29(2):127-33.
- Tan E, Brainard A, Larkin GL. Acceptability of the flipped classroom approach for in-house teaching in emergency medicine. *Emerg Med Australas*. 2015; 27:453-9.
- Hoover CA, Dinndorf-Hogenson GA, Peterson JL, Tollefson BR, Berndt JL, Laudenbach N. Flipped Classroom: Do Students Perceive Readiness for Advanced Discussion? *J Nurs Educ*. 2018;57(3):163-5.
- Özbay Ö, Çınar S. Effectiveness of flipped classroom teaching models in nursing education: A systematic review. *Nurse Education Today*. 2021; 102:104922.
- Flores Ö, del-Arco I, Silva P. The flipped classroom model at the university: analysis based on professors' and students' assessment in the educational field. *Int J Educ Technol High Educ*. 2016; 13(21).
- Mohammadimehr M, Mirmoghtadaie Z. Exploring the components of student support system in blended learning for Iranian Universities of Medical Sciences: A thematic analysis. *J Edu Health Promot*. 2021; 10:130.
- Lew EK. Creating a contemporary clerkship curriculum: the flipped classroom model in emergency medicine. *Int J Emerg Med*. 2016;9(1):25.
- Rose E, Claudius I, Tabatabai R, Kearn L, Behar S, Jhun P. The Flipped Classroom in Emergency Medicine Using Online Videos with Interpolated Questions. *J Emerg Med*. 2016;51(3):284-91. e1.
- Liebert CA, Mazer L, Berekyei Merrell S, Lin DT, Lau JN. Student perceptions of a simulation-based flipped classroom for the surgery clerkship: A mixed-methods study. *Surgery*. 2016;160(3):591-8.