



The Effectiveness of the Flipped Classroom from the Perspective of Medical Students: A Systematic Review of the Literature

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Abstract

Background: The rapid growth and pervasiveness of the Internet have led to the advance of online technologies and dramatic changes in teaching and learning methods. One of these methods is the Flipped Classroom. The present study reviews the studies on the effectiveness of the Flipped Classroom from the perspective of Iranian medical students.

Materials and Methods: In this systematic review, a systemic search of online databases (Medline, EMBASE, Scopus, Web of Science, Cochrane Library, CIVILICA, Magiran, SID, and Google Scholar search engine) was conducted for related studies in reliable Persian and English databases with no time limit up to January 2022. Two reviewers carried out the study selection.

Results: Finally, seven studies with a sample size of 440 medical students were included in the study. The results showed that 90% of students believed that this educational method improves learning, 80% believed that it increases their interest in learning and participation, and 41.8% believed that this method reduces stress in the classroom. The majority of students (79.1%) preferred flipped classroom teaching to the traditional method. This educational method also created satisfaction, self-regulated learning, more attractiveness, and better motivation in students' learning. In the flipped classroom, students were more willing to participate and engaged in much interaction, discussion, and critical thinking.

Conclusion: Flipped classroom teaching improves learning, reduces classroom stress, and increases student satisfaction. Due to the high volume of educational content in medical science education and the limited opportunity in the classrooms, this educational method and other student-centered methods are recommended.

Key Words: Flipped Classroom, Effect, Iran, Medical Sciences, Satisfaction, Students.

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1- INTRODUCTION

Traditional lectures are still the main teaching method in universities. It is, however, criticized by educational experts (1). In lecturing, learners' attention and participation are reduced, and it is not suitable for all learners, and the memorization of the taught material is inefficient (2-4). Teachers have turned to inclusive methods and involve students as active learners to overcome the limitations of traditional teaching methods (5). The rapid growth and pervasiveness of the Internet have led to the progress of online technologies and dramatic changes in teaching and learning methods (6-10).

One of these methods is the Flipped Classroom, where the educational space is changed from a large place to an individual learning space. It involves the presentation of curriculum content outside the classroom, engages the learners, and connects learning content to the needs of students' work and life, and the classroom is dedicated to solving problems (11). The inverted classroom teaching method is widely used in various disciplines, including medical sciences. The method of transmitting findings and information of medical sciences has always been of great importance among medical sciences professors (9). In addition to sufficient knowledge, achieving the habits of thinking and correct judgment in students of medical sciences is essential and requires a special teaching method (10).

A challenge facing medical professors is the large content of medical education and limited classroom opportunities. Traditional, classroom-based medical education is no longer the answer, and new methods are necessary (9). Despite the large number of studies examining the effect of the inverted classroom in higher education, few articles have reviewed related research on medical students in Iran. This study aimed to review the studies conducted on the effectiveness of

the flipped classroom from the perspective of Iranian medical students.

2- MATERIALS AND METHODS

The Preferred Reporting Items for Systematic review and Meta-Analysis (PRISMA) checklist was used as the template for this review (12).

2-1. Eligibility criteria

Participants, interventions, comparators, and outcome (PICO) was used to formulate the review objective and inclusion criteria.

2-1-1. Participants: Iranian medical students.

2-1-2. Interventions: The included research are non- interventional studies, so we did not have comparison group.

2-1-3. Comparators: We did not have a comparison group and intervention.

2-1-4. Outcomes: Effectiveness of the Flipped Classroom.

2-1-2. Included studies: Quantitative (e.g., controlled studies, before and after studies, post-course studies, longitudinal studies); and qualitative (e.g. action research, case studies), were included. Studies were published in English or Persian languages up to January 2022.

2-1-3. Exclusion criteria: The exclusion criteria were abstracts not linked to the full article, articles not written in English or Persian, reviews or meta-analyses, letters to the editor, editorials, short reports, case reports, pilot, preliminary, and briefs.

2-2. Information sources

To identify Persian-language articles, first, the keywords were searched individually in CIVILICA, Magiran, SID, and Google Scholar search engine, and the search results were stored. Then, further searches were performed by combining the keywords using the AND/OR operators

with the Persian equivalents of the words. To identify the English-language articles of Iranian authors, in addition to the national databases, the databases of Medline (via PubMed), Cochrane Library, EMBASE, Scopus, Web of Science, CIVILICA, Magiran, SID, and Google Scholar search engine were searched. The search was done independently and in duplication by two reviewers, and any disagreement between the reviews was dissolved by the supervisor.

2-3. Search

Search words were a combination of (Flipped classroom OR Backward class OR Reverse teaching OR Reverse instruction OR Substitute class) AND (Satisfaction OR Attitude OR Perspective) AND (Iranian Medical Students OR Iranian University Students OR Medical OR Students).

2-4. Study selection

Database search was done for possible studies, study abstracts were screened for eligible studies, full-text articles were obtained and assessed, and a final list of included studies was made. This process was done independently and in duplication by two reviewers, and any disagreement was resolved by the third reviewer. References were organized and managed using EndNote software (version X8).

2-5. Data collection

A researcher form was developed and followed for each study. Two reviewers collected the data independently. The collected data were combined and compared for accuracy, and any discrepancies were solved by a third reviewer.

2-6. Risk of bias in individual studies

A risk of bias assessment was done using the Newcastle–Ottawa scale (NOS). NOS is a valuable tool to evaluate the quality of non-randomized studies included in a systematic review and/or meta-analyses. The NOS had three categorical criteria with a maximum score of 9 points. The quality of each study was rated using the following scoring algorithms: ≥ 7 points was considered "good", 2 to 6 points was considered "fair", and ≤ 1 point was considered "poor" quality (13). The assessment was done by two reviewers independently and in duplication, and any discrepancies were resolved by the third reviewer.

3- RESULTS

The high volume of course content, the long breaks between classes for different reasons, time constraints, and learning challenges at different cognitive levels have led teachers to modify existing methods and use new teaching methods. According to the theories of educational psychologists, learning will be better and more effective when accompanied by the activity and participation of students in learning. One of the strategies emphasized today is the flipped classroom method, also known as the backward classroom, the Thayer method, substitute classroom, reverse teaching, and inverted teaching (14). With the development of educational technologies, the tendency to use online teaching methods and blended learning, which are comprehensive approaches, has increased (15). In this review article, seven articles with a sample size of 440 Iranian medical students from the fields of medicine, dentistry, pharmacy, and nursing were studied (**Figure. 1**).

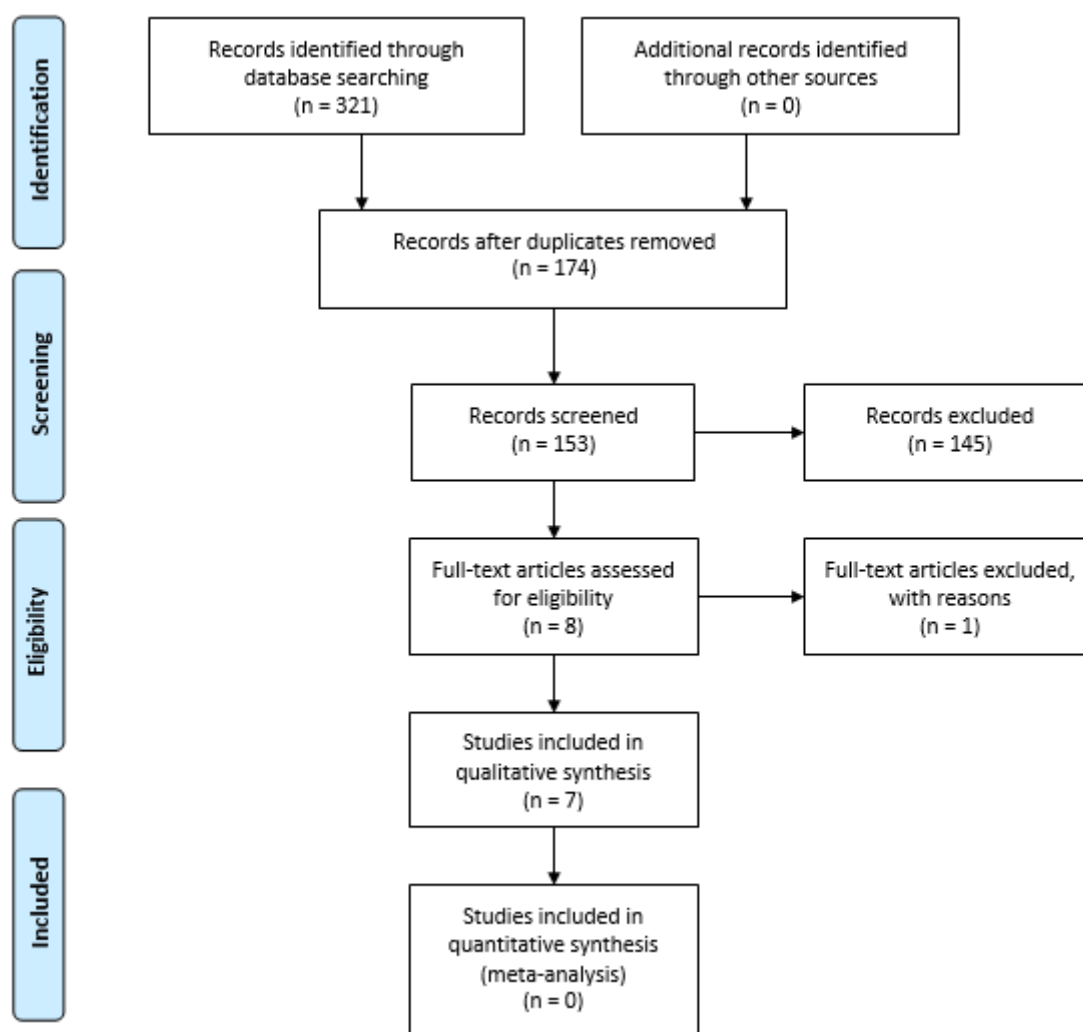


Fig.1: PRISMA Flowchart.

The main characteristics of the selected studies are summarized below:

1. A quasi-experimental study on 102 physiopathology medical students evaluated the effectiveness of the web-based flipped classroom and the satisfaction of medical students with this method compared with lecture teaching. The results showed that the students in the intervention group scored higher than the control group ($p < 0.05$). Also, the students' satisfaction score in the intervention group was significantly higher than the control group ($p < 0.05$) (16).

2. In a cross-over study on 28 sixth- and eighth-semester dental students of

Golestan University of Medical Sciences, the flipped classroom teaching method was used to improve students' knowledge and satisfaction in periodontics and pediatric wards. The results showed that students preferred the inverted class method to the lecture method and were satisfied with its use to teach the desired courses (17).

3. A cross-sectional study on 111 medical students of Birjand University of Medical Sciences examined the students' views on teaching coronary artery disease by the flipped classroom method. The results showed that 90% of students considered this educational method to help learn better about coronary arteries. A total of 80% of students believed that this method

increased their interest in learning and participation, and 41.8% of students believed that this method of teaching reduced stress in the classroom (18).

4. A developmental study was conducted on 34 fifth-semester pharmacy students of Gilan University of Medical Sciences with the aim of designing, implementing, and evaluating flipped classroom teaching. The results showed that this method is more attractive and motivates students to learn. Students were also more willing to participate in the classroom. Also, due to the practical content of the course, there was a lot of interaction, discussion, and challenge between students (19).

5. A quasi-experimental study on 36 nursing students of Meybod School of Nursing, Yazd, aimed to determine the effect of the flipped classroom on the self-directed learning readiness of nursing students. The results showed that using the flipped classroom method has a positive effect on the self-directed learning readiness of nursing students. There was a statistically significant difference between self-directed learning readiness before and after the intervention ($p=0.004$). Also, a significant difference was observed in the field of interest in learning ($p=0.001$). However, there was no significant difference in self-control and self-management domains ($p>0.05$) (20).

6. A quasi-experimental study on 60 seventh-semester nursing students compared the effect of the flipped classroom and traditional education on the knowledge of using the selected medical equipment at the Yazd University of Medical Sciences. The results showed that both lecturing and the flipped classroom increased the knowledge of using the selected medical equipment in both groups of students. However, the effect on the knowledge was greater in the flipped classroom group ($p<0.05$) (21).

7. A quasi-experimental study on 43 nursing students of Islamic Azad University of Rasht examined the views and experiences of nursing students on the flipped classroom educational model. The results showed positive experiences of learners using the flipped classroom method. The majority of students (79.1%) preferred flipped classroom teaching to the traditional methods, where most of the class time is spent lecturing by the teacher. There was a positive and significant correlation between students' perspectives and grade point average (22).

4- DISCUSSION

The present study reviewed the studies on the effectiveness of the flipped classroom from the perspective of Iranian medical students. The results showed that the flipped classroom method improved students' learning and increased their satisfaction. Students preferred the flipped classroom method to the lecture method, and this educational method created more interest and motivation in students' learning.

Nowadays, teachers have turned to inclusive methods and involving students as active learners to overcome the limitations of traditional teaching methods (5). The flipped classroom is one such method introduced to make the teaching more attractive and increase students' learning. The flipped classroom is a combined method where educational content is prepared with new technologies outside the classroom and in the form of video, multimedia, audio files as well as printed texts and with the help of data technology and in the context of global networks such as the Internet, social networks, or local networks and is provided to learners before the start of the class. In the classroom, discussion, exchange, and problem-solving take place according to the content presented in advance. This educational method is

designed based on the theory of adult education, which emphasizes the significance of learning and its direct relationship with the work and life of learners, and recognizes the success of educational goals in attracting their active participation (11, 23-28). Domestic studies indicate that the flipped classroom has improved the academic performance of pharmacy, nursing, medical, and dental students (16-22). There is also evidence that the flipped classroom creates opportunities to develop critical thinking skills (29), and makes the best use of students' learning time (30). However, some studies have shown negative effects of this method on learners' satisfaction (31), and indicate that the flipped classroom does not bring better learning outcomes compared to other active learning methods (32).

In qualitative studies in this field, researchers have discussed the advantages and disadvantages of and the negative factors affecting the flipped classroom, such as quantity and quality of teaching materials, teacher's role in involving students in active learning, and emphasis on knowledge application (33, 34). The flipped classroom is a new pedagogical model in e-learning, but it also requires special features and conditions. Inverted education requires a change in learning culture, a flexible learning environment, goal-oriented content, and experienced and professional instructors. Although this teaching method creates a learner-centered classroom, it cannot be considered a solution for all educational problems. There is a need for quantitative and qualitative research to identify the potential of this educational method in Iran and strategies to apply it at different levels of student learning.

5- CONCLUSION

Although traditional teaching methods are often simpler to implement than

modern methods, when teaching effectiveness and quality of learning are considered, it is necessary to use new methods and technologies. The flipped classroom is one of these educational strategies that improves learning, reduces stress in the classroom, and increases students' satisfaction. Attractiveness, reducing classroom time, being interactive, paying attention to student needs, and providing feedback are other benefits of this educational method. Due to the high volume of educational materials in medical science education and the limited opportunities in the classroom, the use of this educational method and other student-centered methods is recommended.

6- AUTHORS' CONTRIBUTIONS

Study conception or design: MN and SV; Data analyzing and draft manuscript preparation: ND and MB; Critical revision of the paper: MN and ND; Supervision of the research: MN and SV; Final approval of the version to be published: MN, ND, MB, and SV.

7- CONFLICT OF INTEREST: None.

8- REFERENCES

1. Gilboy MB, Heinerichs S, Pazzaglia G. Enhancing Student Engagement Using the Flipped Classroom. *J Nutr Educ Behav*. 2015; 47(1):109- 14.
2. McLaughlin JE, Roth MT, Glatt DM, et al. The flipped classroom: a course redesign to foster learning and engagement in a health professions school. *Acad Med*. 2014; 89(2):236-43.
3. Critz CM, Knight D. Using the flipped classroom in graduate nursing education. *Nurse Educ* 2013; 38(5):210-3.
4. Clark KR. Flipping out: A trend in radiologic science education. *Radiol Technol*. 2014; 85(6):685-7.
5. Della Ratta CB. Flipping the classroom with team-based learning in undergraduate nursing education. *Nurse Educ*. 2015; 40(2):71-4.

6. Wittich CM, Agrawal A, Wang AT, Halvorsen AJ, Mandrekar JN, Chaudhry S, et al. Flipped classrooms in graduate medical education: a national survey of residency program directors. *Academic medicine*, 2018;93:471 -7.
7. Saunders A, Green R, Cross M. Making the most of person -centred education by integrating flipped and simulated teaching: An exploratory study. *Nurse Educ Pract* 2017;27:71-7.
8. Kowalski K, Horner MD. Preparing Educators to Implement Flipped Classrooms as a Teaching Strategy. *J Contin Educ Nurs* 2015;46: 346-7.
9. Bullock A, Webb K. Technology in postgraduate medical education: a dynamic influence on learning? *Postgrad Med J* 2015; 91: 646 -50 .
10. Wright EA, Brown B, Gettig J, Martello JL, McClendon KS, Smith KM, et al. Teaching and learning curriculum programs: recommendations for postgraduate pharmacy experiences in education. *Am J Health Syst Pharm* 2014; 71: 1292 -302.
11. Pickering JD, Roberts DJH. Flipped classroom or an active lecture? *Clin Anat* 2018;31:118 -21.
12. Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev* 2015; 4: 1.
13. Deeks JJ, Dinnes J, D'Amico R, Sowden AJ, Sakarovich C, Song F, et al. Evaluating non-randomised intervention studies. *Health Technology Assessment*, 2003; 7 (27): 27.
14. Haghani F, Rezaei H, Eghbali B. Flipped classroom: A pedagogical method. *Iranian Journal of Medical Education*. 2016 Apr 10;16:104-19.
15. O'Flaherty J, Phillips C. The use of flipped classrooms in higher education: A scoping review. *The Internet High Educ*. 2015; 25:85-95.
16. Mortazavimoghaddam S G, Allahyari E, Vahedi F, Zare Bidaki M. The Effect of Web-based Flipped Classroom Approach on Learning and Satisfaction of Medical Students Comparison with Lecture-based Method. *jmed*. 2021; 16 (3) :207-215.
17. Fakhari E, Seyfi N, Najafi M, Vakili MA. Process of the utilizing of flipped classroom for knowledge and satisfaction improvement of dental students in the periodontal and pediatric per clinical courses. *Teb va Tazkiye*, 2017; 26 (3): 213-18.
18. Kazemi T, Moezzi A, Azdaki N, Ramazanzade K, Amirabadizadeh N, Khosravi Bizhaem S. Study of physiopathic students viewpoints toward Coronary Artery Disease Education by using the inverted class method. *DSME*. 2021; 8 (1) :13-22.
19. Aboutaleb E, Motavallian A, Dadgaran I, Manoochehri S. Design, implementation and evaluation of teaching module of liquid dosage form in a Flipped Classroom for pharmacy students. *RME*. 2019; 11 (4) :35-44.
20. Dadgari A, Bagheri I, Salmani N. The effect of flipped education on the Self-directed learning readiness nursing students in the illnesses pediatric nursing lesson. *Educ Strategy Med Sci*. 2020; 13 (4) :287-94.
21. Mir Dehghan F, Keshmiri F, Shakerfar H, Nasiriani K. Comparison the Effect of Flipped Classroom and Traditional Education on the Knowledge of Using Selected Medical Equipment in Nursing Students. *mededj*. 2021; 9 (1):59-71.
22. Jafaraghaie F, Dehghanzadeh S, Khordadi-Astane H. Nursing students' experience in a flipped classroom method . *RME*. 2017;9(1):36-27.
23. Hew KF, Lo CK. Flipped classroom improves student learning in health professions education: a meta -analysis. *BMC Med Edu* 2018 12;18: 38.
24. Pettit RK, McCoy L, Kinney M. What millennial medical students say about flipped learning. *dv Med Educ Pract* 2017;8:487 -97 .
25. Tainter CR, Wong NL, Cudemus -Deseda GA, Bittner EA. The “flipped classroom” model for teaching in the intensive care unit: rationale, practical considerations, and an example of successful implementation. *J Intensive Care Med* 2017;32:187-96.
26. Liebert CA, Lin DT, Mazer LM, Bereksnyi S, Lau JN. Effectiveness of the

surgery core clerkship flipped classroom: a prospective cohort trial. *Am J Surg* 2016;211:451-7.

27. Carrick FR, Abdulrahman M, Hankir A, Zayaruzny M, Najem K, Lungchukiet P, et al. Randomized controlled study of a remote flipped classroom neuro -otology curriculum. *Front Neurol* 2017;8:349 . 28. Moraros J, Islam A, Yu S, Banow R, Schindelka B. Flipping for success: evaluating the effectiveness of a novel teaching approach in a graduate level setting. *BMC Me Edu* 2015;15:27.

29. Horn MB. The transformational potential of flipped classrooms. *Educ Next*. 2013; 13(3):56-69.

30. Morgan H, McLean K, Chapman C, Fitzgerald J, Yousuf A, Hammoud M. The flipped classroom for medical students. *Clin Teach*. 2015; 12(3):155-60.

31. Wong TH, Ip EJ, Lopes I, Rajagopalan V. Pharmacy students' performance and perceptions in a flipped teaching pilot on cardiac arrhythmias. *Am j pharm Educ*. 2014; 78(10):1-6.

32. Jensen JL, Kummer TA, Godoy PDdM. Improvements from a Flipped Classroom may simply be the fruits of active Learning. *CBE Life Sci Educ*. 2015; 14(1):1-12.

33. Khanova J, Roth MT, Rodgers JE, McLaughlin JE. Student experiences across multiple flipped courses in a single curriculum. *Med Educ*. 2015; 49(10): 1038-48.

34. Post JL, Deal B, Hermanns M. Implementation of a flipped classroom: Nursing students' perspectives. *J Nurs Educ Pract*. 2015; 5(6):25-34.