



The Effect of Flipped Classroom on Student Learning Outcomes; An Overview

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Abstract

Background: In flipped classrooms (FCs), teaching takes place before class. This study reviews the evidence of the effectiveness of flipped classrooms compared to traditional teaching and examines the effects of FCs on student learning outcomes.

Materials and Methods: In this overview, two independent researchers screened the articles studying the effect of flipped classrooms on students learning on databases Scopus, EMBASE, Cochrane, Web of Science, ERIC, and Medline without time and language restrictions up to Feb 10, 2022.

Results: A total of 14 systematic reviews and meta-analyses (including 699 studies from 2010 to 2022) were reviewed. Results showed that the FC is fitting with the revised Bloom's Taxonomy and has positive effects on student learning activities such as academic performance, learning motivation and engagement, social interaction, self-directed learning skills, brain-based learning, problem-based learning, multiple intelligence, student understanding, student participation, student attitudes, and lowering student anxiety. On the other hand, a meta-analysis of 271 studies showed a slight effect of the FC on learning (Hedges' $g = 0.35$, 95% CI [0.31, 0.40]), and effects on student satisfaction (Hedges' $g = 0.16$, 95% CI [0.06, 0.26]) were also small. Meanwhile, some challenges were also identified, such as challenges for students (lack of student motivation to watch the pre-recorded video lectures), for teachers (the need for more preparation, difficulty controlling pre-class activities of students), and technical challenges (problem of technology and internet access).

Conclusion: Although flipped classrooms are effective alternatives in teaching and learning, the evidence is still not enough to conclude the advantages of FC over the traditional approach, and flipped classrooms may not be suitable for every course, teacher, or student.

Key Words: Flipped classroom, Effect, Students, Teachers.

*Please cite this article as: Ghazizadeh Hashemi AH, Jasim Alsadaji A, Jasim Mohammed Z, Saeidi M. The Effect of Flipped Classroom on Student Learning Outcomes; An Overview. Med Edu Bull 2022; 3(2): 425-34. DOI: [10.22034/MEB.2022.332357.1052](https://doi.org/10.22034/MEB.2022.332357.1052)

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Received date: Feb. 15, 2022; Accepted date: Mar.22, 2022

1- INTRODUCTION

Nowadays, traditional lectures classrooms do not have the necessary effectiveness (1). The needs, goals, and performance of learners have also changed over the past few years. Learners often have quick and easy access to information and prefer to be present in collaborative and learner-centered learning environments. Flipped classrooms (FCs), also known as inverted classrooms, inverted learning, and reverse classrooms, are an educational model where the traditional lecturing and the way students do their homework change (2). According to Bishop and Verleger, the flipped classroom is an educational approach supported by technology that consists of two components, individual and direct computer-based training outside the classroom through video lectures and interactive group activities within the classroom. This definition emphasizes the use of instructional videos in extracurricular learning (3).

Active learning focuses on the learner's activity and mental engagement with the educational content, and the flipped classroom is an approach to the learner's activity and the use of course materials simultaneously (5, 4). Back in his classroom activities at Harvard University in the 1990s, Eric Mazur allowed his students to choose the content that best suited their needs. His students could choose textual, interactive, or problem-solving content (6). The idea was first used to improve learning in undergraduate physics classes at Harvard University and gradually spread around the world in various fields and disciplines. Despite the emphasis on this method by higher education professionals to teach all educational-theoretical or practical subjects, this method has been used more to learn theoretical subjects (7). Most research confirms that the flipped classroom approach has a positive effect

on student learning (8-17). However, some studies have reported the ineffectiveness of the flipped classroom approach (11, 15, 17-23). Due to the contradictory studies on this educational method, this study aimed to review systematic studies on the effectiveness of the flipped classroom on learning and examine the strengths and weaknesses of this educational method.

2- MATERIALS AND METHODS

In this overview, all systematic reviews and meta-analyses evaluating the effects of the flipped classroom on student learning were searched on the electronic databases of Scopus, EMBASE, Cochrane, Web of Science, ERIC, and Medline (via PubMed) with no language or time restrictions (up to Feb 10, 2022). Two independent researchers performed the search process, and a supervisor resolved any discrepancies in this regard. The two reviewers initially reviewed the abstracts of searched articles, downloaded their full texts to review carefully, and selected the relevant studies independently. Finally, the articles that met the inclusion criteria were enrolled in the review, and relevant references were reviewed to find further studies. The third reviewer resolved possible discrepancies.

3- RESULTS

A total of 14 related systematic reviews (n=10), and meta-analyses (n=4) were selected for the overview. The results showed that the flipped classroom model was applied in various educational disciplines.

A systematic review of 38 studies from 2012 to 2016 investigated how to use the reverse class approach in higher education, its advantages and disadvantages, and the extent of its impact on various aspects of education, including learning. The results showed that this approach has a positive effect on learning, cognitive load, engagement, accuracy, motivation,

attitude, satisfaction with the course, and self-efficacy in higher education. It indicated that one of the most important challenges of the flipped classroom is the lack of familiarity and appropriate adaptation of students with the reverse method, increasing the workload of teachers and problems in learning from videos (24).

A systematic review of studies on the flipped classroom conducted in Turkey (including 38 studies published from 2014 to 2017) showed that the flipped classrooms are an effective method compared to traditional lecture-based classrooms, particularly in student achievements, developing positive attitudes, and increasing motivation towards the course. Moreover, despite the technical problems, students mostly asserted positive opinions about flipped classrooms (25).

A meta-analysis in 2018 examined the effectiveness of the flipped classroom compared to traditional lectures. It included six studies in the qualitative synthesis and five in the quantitative synthesis. Despite a lack of prospective randomized studies, findings of this meta-analysis suggest that flipped classrooms may result in minimal gains in student knowledge compared to lectures. These findings are important as previous research has shown that the flipped classroom requires more time for development and implementation. Future studies with prospective randomized designs need to be conducted before the widespread adoption of flipped classrooms (26).

A meta-analysis of 69 studies from 2011 to 2019 investigated the relative effectiveness of flipped learning regarding students' achievements in the ESL/EFL (English as a second/ foreign language) context. The results showed that flipped learning could improve students' achievements when used well. However, the satisfactory application of this approach involves the

practices that require judgment from the instructors using the approach. Moreover, this approach can be more effective when students are required to practice new materials with extra activities before entering the classroom. It somehow increases the readiness of students for face-to-face class time (27).

A meta-analysis of 271 studies from 2010 to 2017 investigated the effects of flipped classroom interventions on student learning outcomes and satisfaction. The results showed small positive effects of the flipped classroom on learning (Hedges' $g = 0.35$, 95% confidence interval [CI] [0.31, 0.40], $k = 272$). However, analyses of studies with sufficient power resulted in an estimate of 0.24 (95% CI [0.18, 0.31], $k = 90$). Effects on passing rates (odds ratio = 1.55, 95% CI [1.34, 1.78], $k = 45$) and student satisfaction (Hedges' $g = 0.16$, 95% CI [0.06, 0.26], $k = 69$) were small and also likely influenced by publication bias (28).

In a systematic review of 16 studies on the effect of FC in 2018, results showed that on the one hand, it is difficult to guarantee the learning of students. On the other hand, using active methodologies, such as the flipped classroom, the object of this study, in pedagogical practices will show their potential in active classes (29).

A systematic review of 33 articles on the flipped classroom for physics learning from 2016 to April 2021 investigated the trends of the flipped classroom for physics learning. The results showed that, compared to traditional classrooms, the implementation of the flipping classroom in a physics course had a positive impact on student achievements such as improving physics learning, student motivation, student self-direction in learning, student understanding, student participation, positive attitudes, and decreasing student anxiety. On the other hand, some challenges were also identified, such as challenges for students

(students need more motivation to do pre-class activities, students cannot ask questions before class), and teachers (teachers need more preparation, teachers have difficulty controlling pre-class activities of students), and technical challenges (problems with technology and internet access) (30).

A systematic review of 18 studies from 2016 to 2020 explored the perception of English language teachers and learners of the flipped classroom. The results indicated that most of the teachers and learners who participated in the past studies agreed that the flipped classroom approach is beneficial for teaching and learning the English language. There were challenges in implementing the flipped classroom approach. Teachers and learners should be literate in technology and ICT and need to upgrade their knowledge to apply the flipped classroom in their teaching and learning process (31).

A systematic review was conducted of 78 studies on the implementations of flipped classrooms in K-12 and universities from 2016 to 2020. The review aimed to identify considerations for designing content, pedagogy, materials, delivery, and assessment before flipping a course. The results showed that the flipped classroom shares characteristics with pedagogical approaches such as mastery learning, active learning, brain-based learning, problem-based learning, and multiple intelligence. Flipped classrooms may not be suitable for every course, teacher, or student. Choosing a course to flip is a significant decision and requires a careful assessment of students' expectations and needs before the process of designing a flipped course. Hence, if teachers consider the content, pedagogy, material, delivery, and designs carefully, they can develop a flipped course that supports students in acquiring conceptual knowledge and higher-order thinking skills and may produce better results (32).

A systematic review of nine studies in 2016 examined the scope and quality of studies on the FC teaching in medical education and its effects on medical learning. The results showed that the FC is a promising teaching approach, particularly to increase learners' motivation, task value, and engagement. Students generally liked the FC method of education. Although the results were mixed regarding the improvement of knowledge and skills, the FC was at least as effective as traditional education in these outcomes. Educational practices require more studies examining the long-term impact of the FC on knowledge retention and the transfer of knowledge to professional practice and patient care (33).

A systematic review of 48 studies in 2017 and 2018 analyzed the trends and contents of flipped classroom research. The results showed that the flipped classroom had positive impacts on aspects of student learning such as academic performance, learning motivation and engagement, social interaction, and self-directed learning skills. Meanwhile, the most significant challenges of instructors was the lack of students' motivation to watch the pre-recorded video lectures or to study the contents outside of the class time (34).

A systematic review of 27 studies in November 2019 evaluated the empirical evidence and literature on the development, application, and effectiveness of flipped classrooms in undergraduate nursing education. The results showed that a common operational flipped classroom model has three key components of pre-classroom activities, in-classroom activities, and post-classroom activities, guided by two instructional system design principles. The review identified predominantly positive learning outcomes among undergraduate nursing students in skills, knowledge, and attitudes. However, a few studies reported contrasting findings. It can be due to the

incompatibility of the flipped classroom pedagogy with the traditional learning culture (35).

A systematic review of 12 studies from 2012 to 2017 studied the current articles on the flipped classroom in mathematics and investigated the effect of the flipped classroom on mathematics learning. The results showed that the effect of flipped classrooms in enhancing the academic performance and perception of students is still uncertain. Although the flipped classroom is an effective alternative teaching and learning strategy, the evidence is still not conclusive in the advantage of the flipped classroom over the traditional approach in terms of students' academic performance and perception (36).

A meta-analysis of 12 studies until March 2020 compared the academic performance of students in introductory statistics for non-math majors using the FC with those taught in the LC. The results showed that students in the FC had statistically higher final performance outcomes than the LC. These findings suggest that implementing the FC in introductory statistics at the undergraduate level may improve learning achievement, but more research is needed to explore the role of regular class quizzes (37).

A systematic review of 24 studies from 2013 to 2020 examined the application of the flipped classroom in nursing education and its outcome. The results showed that the flipped classroom method supported learning effectively and increased the quality of teaching. Nursing courses are recommended to apply flipped classrooms (38).

4- DISCUSSION

This review investigated the effectiveness of flipped classrooms compared with traditional teaching and examined the effects of FCs on student

learning outcomes. Results showed that the FC improved student learning activities such as academic performance, learning motivation, and engagement and decreased student anxiety. Meanwhile, challenges were also identified for students (lack of motivation to watch the pre-recorded video lectures or to study the contents outside of the class time), and teachers (teachers needed more preparation and had difficulty controlling pre-class activities of students), and technical challenges (problems with technology and internet access). A flipped classroom is an instructional strategy and a type of blended learning. It aims to increase student engagement and learning by having them complete readings at home and work on live problem-solving during class time (38). This pedagogical style moves activities, including those traditionally considered homework, into the classroom. In a flipped classroom, students watch online lectures, collaborate in online discussions, or carry out research at home while actively discussing concepts in the classroom with a mentor's guidance. In traditional instruction, the teacher is typically the leader of a lesson, the focus of attention, and the primary disseminator of information in the class. The teacher responds to questions while students defer directly to the teacher for guidance and feedback. Many traditional instructional models rely on lecture-style presentations of individual lessons, limiting student engagement to activities where they work independently or in small groups on tasks devised by the teacher. The teacher typically takes a central role in class discussions, controlling the conversation flow (39). This style of teaching typically involves giving students homework of reading textbooks or practicing concepts by working, for example, on problem sets (40). The flipped classroom intentionally shifts instruction to a learner-centered model, where students are initially introduced to new topics outside of class, freeing up classroom time for exploring

topics in greater depth and creating meaningful learning opportunities. With a flipped classroom, 'content delivery' takes various forms, often featuring video lessons prepared by the teacher or third parties. However, online collaborative discussions, digital research, and text readings may also be used (41- 45). The flipped classroom is a learner-centered learning method and is derived from theories and methods such as constructivism, active learning, and peer-to-peer learning (43). When learners learn the target content independently before class, there is more time for classroom interaction and collaborative learning for teachers and learners. In other words, classroom interaction between learners and the teacher is increased by reducing the teaching time, and learners have more time for activities in the classroom and learn pre-class content (46).

This way, learners become responsible for their learning by controlling the speed of learning and mastering the content, and their practical and problem-solving skills are improved. An environment of interaction and close collaboration and communication is provided, and learning is facilitated for beginners through discussion with more advanced learners and teachers, and they achieve better memorization results (47-49). This educational method can help learners put their learning to practice due to possibilities such as video demonstration of skill training, active learning by the learner, instructor supervision on learners' performance, and facilitation of learning and performance (50). In traditional learning, lower levels of learning such as remembering and understanding take place in class, while students are usually left to work on activities on higher levels of learning outside of the classroom. However, in the flipped classroom model, learning is flipped, so students can finish the lower level of cognitive work before the class

and can engage in higher cognitive levels of learning in class with peers and the teacher present (**Figure 1**).

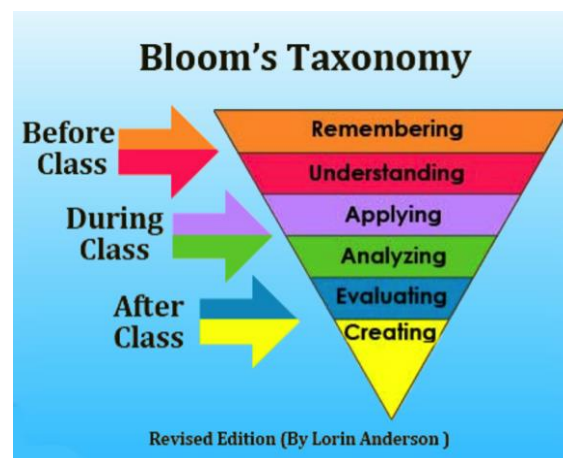


Fig.1: Revised Bloom's Taxonomy.

The flipped classroom has strong theoretical foundations. The most important is the blended learning approach (51). Blended learning uses a combination of different methods such as online presentation with face-to-face interactions and enables the learner to control their learning space and speed. The second important theoretical basis of the flipped classroom is the learner-centered approach (52). This approach moves from an environment where the teacher is the speaker and performs all educational activities to where the teacher is the facilitator, supervisor, and organizer. This way, learners have a sense of responsibility and an initial understanding of the subject matter in the classroom and can participate in activities related to interactive learning (12). The third theoretical basis of the flipped classroom is active learning (53). Active learning focuses on the learner's activity and mental engagement with the educational content, and the flipped classroom focuses on the learner's activity and the use of course materials simultaneously (4). Each training method has advantages and disadvantages and is not complete on its own. It is the duty of the teacher to put together the

strengths of educational methods and develop an effective and memorable teaching method for learners.

5- CONCLUSION

The flipped classroom is founded on learner-centered learning and theories and methods such as constructivism, active learning, and peer-to-peer learning. In the flipped class method, the lower levels of Bloom's cognitive domain (knowledge and understanding) can be delivered to the learner by the individual initial training (online or video training). Then, the class time can be used for the higher levels of learning (application, analysis, and evaluation) and improving learning by devoting more time to group activities, problem-based learning, and other active learning strategies. The flipped classroom approach improves learning, cognitive load reduction, engagement, accuracy, motivation, attitude, satisfaction with the course, and self-efficacy in learners. The effectiveness of this method is associated with exploration-based and project-based active learning. Learners watch videos and read instructional materials before class, improving their self-regulation of learning. Receiving feedback from the teacher in the classroom, teacher guidance, and classroom interaction between learners and collaborative participation help them succeed in their homework. In this way, learners are responsible for their learning and performance; they study relevant resources according to their learning speed, their anxiety is minimized, and they become eager to continue learning activities. Meanwhile, challenges were also identified for students (lack of motivation to watch the video lectures or to study the contents outside of the class time) and teachers (teachers need more preparation and have difficulty controlling students' pre-class activities, and their workload is higher), and technical challenges (problems with technology and internet access).

6- AUTHORS' CONTRIBUTIONS

Study conception or design: AG, and MS; Data analyzing and draft manuscript preparation: AJ and ZJ; Critical revision of the paper: AG, and MS; Supervision of the research: AG and MS; Final approval of the version to be published: AG, AJ, ZJ, and MS.

7- CONFLICT OF INTEREST: None.

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