

Flipped Classroom in Secondary School or High School Education: A Review of Its Advantages and Challenges

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ABSTRACT

Advanced technology in education provides various facilities to enhance students' learning. The evolution of technology has become an integral part of sustaining life, especially in education. The technology in education develops and continues its development with innovative learning approaches to sustain the needs of the 21st-century learning environment. The transformation in the educational field takes out the existence of a new strategy that is flipped classroom learning approach. A flipped classroom is a learning approach that is a type of blended learning that involves face-to-face and online learning instruction. The flipped classroom is a pedagogical approach in which learning activities that have traditionally taken place inside the classroom occur outside the classroom and vice versa. Flipped classroom provides an interactive learning environment where teachers guide students as they engage actively in the subject matter. Thus, this paper will review the recent literature regarding the potential of flipped classroom technology in education and explore its advantages and challenges. The review describes the potential of the flipped classroom in various fields of education, including Chemistry, Physics, Mathematics, Biology, and Civics at secondary school or high school level. Searching of the literature was obtained from several databases by using certain Boolean queries when searching the keywords. Ten papers were selected according to the specific criteria. This paper concludes the advantages and challenges during the implementation of FC. The advantages of flipped classroom are increased students' motivation during learning processes, providing active learning, increasing learning perception, increasing learning engagement, enhancing knowledge, increasing teacher-student interaction, increasing peer interaction, enhancing creativity and helping to improve students' achievement and performance. The challenges of FC are the time-consuming for teachers to prepare the learning materials, lack of teachers' technical skills to produce learning videos, lack of students' motivation to watch the pre-class video, and the difficulty of students to understand the contents presented in the learning video. Based on these challenges, this paper provides the literature recommendations that can help to produce effective flipped classroom environments in the future.

Keywords

Blended learning; flipped classroom; secondary school; high school; advantages; challenges

Introduction

The use of technology in the education system positively impacts students, making students more active, creative, and interested in learning (Sudarsana et al., 2019). A suitable teaching method and teaching style should be used to determine the environment of the learning process. Generation Z is represented by people born between 1995 and 2010 (Mohr & Mohr, 2016). Nowadays, generation Z includes the students who study at secondary school or high school level. Generation Z is identified with independent learning type where they desire to choose what they want to learn and how to learn (Iftode et al., 2019). Generation Z is perceived as skillful in using modern technology and interacting through media (Mládková, 2017). According to Dermott (2019), the alternative learning approach for generation Z students is using a Blended Learning (BL) such as Flipped Classroom (FC) approach.

Online learning is widely used in the teaching and learning process, especially in higher education. The combination of online learning with face-to-face learning or commonly called BL (Dziuban et al., 2018), can be applied in the education process. In the BL environment, students can learn face-to-face in the classroom and combine it with online learning. Flipping the classroom is a new approach to be applied in secondary school environments (Schultz et al., 2014). In the FC, a student-centered environment can be applied in which educational technology tools and active learning were used (Siti Hajar & Zamzami, 2015).

Nowadays, the FC is widely used in the education system. A number of reviews have been undertaken by previous scholars to explore the implementation of FC in education. However, most of the scholars reviewed the use of FC in higher education, such as in medical, nursing, engineering, and pharmacy fields. Lack of literature that focuses on the application of FC at the secondary school or high school level. Thus, this paper will provide a review on the potential of the use of FC that focuses at secondary school or high school level.

Defining the Flipped Classroom Approach

The FC model is one of the types of BL. In the FC, learning activities usually conducted traditionally in the classroom can now be conducted outside the classroom. FC was introduced by Bergmann and Sams in 2007 (Halili & Zainuddin, 2015). The idea of FC came when they found the difficulties to re-teach lessons to the students who could not attend the class. They recorded their learning video, posted the video online, and ask the students to watch and learn from the video. From their initiative, finally, all of their students, whether they can attend the class or not, were required to access the learning video at home to review and reinforce classroom lessons (Tucker, 2012). In a traditional classroom, students spend time listening for the explanation of the learning content from the teacher, but with FC, the video of learning materials was provided before class and students need to watch at home, while the classroom contact hours are filled with interactive and collaborative learning opportunities (Rafon & Mistades, 2020). FC environment allows the students to be involved directly in active learning, and because of that, FC contributes a positive impact on student learning outcomes and attitudes toward the learning process (Olanmi, 2017). Educators use FC to flip the traditional lecture classroom into more active learning using technology media as learning instruction (Lumpkin & Achen, 2015). In the FC model, students watch the pre-class video at home and then apply the knowledge obtained from the video to engage actively in learning activities such as problem-solving and discussion during face-to-face learning session at school (Siti Zuraidah, Roziyah & Nur Eliza, 2014).

Significance of Flipped Classroom as the Learning Approach

The FC approach is also known as a student-centered learning process in which the students are actively involved in the learning activities (Zainuddin et al., 2019). The literature from recent studies shows that the FC gives advantages for the teaching and learning process at school. Table 1 summarises the advantages of the FC in the field of education obtained from the literature. The advantages, as shown in Table 1, are the most common advantages of integrating the FC environment in the education field.

Table 1. Common advantages of the flipped classroom in education

Advantages of Flipped Classroom	Author/s
Improves students' performance and academic results	Tsai et al. (2020)
Increase students' motivation	Prasetyo, Suprpto & Pudyastomo (2018); Bhagat, Chang & Chang (2016)
Increase student perception	Unal & Unal (2017)
Increase students' engagement	Aycicek & Yelken (2018)
Students participate actively during the learning process	Leo & Puzio (2016); Gariou-Papalexiou et al., (2017)

The advantages of FC, as stated in Table 1 above, show that the integration of FC in education gives benefits in the teaching and learning process. A number of reviews have been conducted by scholars on the implementation of FC in higher education. However, there is still a lack of paper reviews on the use of FC in education, focusing on secondary school or high school level.

Methodology

This paper reviews the research studies on the use of FC in several fields of education at secondary school or high school level, namely Chemistry, Mathematics, Civics, Physics, and Biology. This paper aims to review the potential of FC in different education fields that focus on secondary school or high school level. This study investigated the scholarly articles published in 2016 until April 2021. Searching of the literature was conducted through electronic databases, namely ScienceDirect, Wiley Online Library, Springer Link, and Google Scholar. A few keywords were used in searching the literature, such as “flipped classroom”, “flipped classroom AND secondary school” and “flipped classroom AND high school”. There were 347 hits from the keyword search in the ScienceDirect database, 567 hits from the keyword search in Wiley Online Library, 258 hits in Springer Link, and 461 hits in Google Scholar. However, only ten papers were selected according to specific criteria. Firstly, the years of studies conducted in which from 2016 to April 2021 were selected. Secondly, the studies must include the use of FC at the secondary school or high school level. Thirdly, the studies represent the use of FC in different education fields at secondary school or high school level to identify the potential of FC in a wide range of education fields. Lastly, the studies include the purpose and the advantages of the use of FC that consists of comprehensive discussion regarding the application of FC at secondary school or high school level. The reviews of advantages are listed from the selected literature regarding the implementation of FC at the secondary school or high school level.

The challenges of implementing the FC include the common challenges during the teaching and learning process. The keyword “challenges AND flipped classroom” were used in searching the literature. The years of studies conducted in which from 2016 to April 2021 were selected. The reviews of the challenges are listed from the literature regarding the challenges during the implementation of FC at the secondary school or high school level.

Findings

The findings of this review paper are briefly described in this section. The findings are related to the review of the advantages and challenges of the implementation of FC.

Review of Advantages of the Flipped Classroom

The findings represent the advantages of the use of FC in different fields of educations. The advantages of implementing the FC are listed based on the reviews of the literature. Table 2 summarises the advantages of FC that are highlighted in the literature.

Table 2. The review of the advantages of flipped classroom in different fields of educations

Author/s	Field	Learning Approach or Theory	Purpose of Flipped Classroom Use	Advantages
Bhagat, Chang & Chang (2016)	Mathematics	Cognitive theory of multimedia learning (CTML)	To examine the effectiveness of the flipped classroom learning environment towards students' achievement and motivation on students with different achievement levels in learning mathematics	(1) Students' learning achievement and motivation that learned using the FC model were better than in the traditional classroom. (2) Low achievers in the flipped classroom group

				performed better than the traditional classroom group.
Leo & Puzio (2016)	Biology	Active learning strategies	To study the effectiveness of using flipped instruction in a 9th-grade biology classroom	(1) Students' assessments of scientific knowledge resulted in better performance when learned using FC (2) Students' interest increased when learning biology.
Olakanmi (2017)	Chemistry	Flipped model of instruction	To study the effect of a flipped classroom model of instruction towards academic performance and attitudes of secondary school students in learning chemistry	(1) Students who learned using the FC model performed better than the students who learned using the traditional method of instruction. (2) FC environment increased students' attitudes towards chemistry.
Gariou-Papalexiou et al. (2017)	Biology	FLIP model	To investigate the effect of the "flipped classroom" learning method on junior high school students in learning biology	Students' involvement actively during the learning process using flipped classroom model.
Halimatus, Basuki & Hartati (2018)	Chemistry	Flipped Classroom and Problem Based Learning	To determine the effect of flipped classroom learning and problem-based learning methods in learning chemistry	Students' levels of achievement in chemistry increased when using flipped instruction, in which the highest score was obtained by the student in FC class, followed by problem-based learning class.
Prasetyo, Suprpto & Pudyastomo (2018)	Physics	Explicit instruction method	To describe the effectiveness of the flipped classroom learning model on secondary school students in learning physics	(1) Students' motivation to study physics increased. (2) Students involve actively in the learning activities.
Paristiowati et al. (2019)	Chemistry	Contextual-flipped classroom learning	To determine the effect of contextual-flipped classroom model on students' scientific literacy skills	(1) Student's achievement levels in scientific literacy increased. (2) Students learned actively and

				independently at home.
Tsai et al. (2020)	Civics	Brainstorming Flipped Classroom	To develop a brainstorming flipped classroom approach for civic education	Increase students' performance, learning motivation for civics, citizen participation, better teacher-student interactions, peer interactions, and creativity.
Rafon & Mistades (2020)	Physics	5E Instructional Model	To study the effect of using the flipped classroom approach and the 5E instructional model in teaching Physics	(1) The students developed a sense of responsibility and actively took part in the discussion (2) The students' positive attitude towards learning increased
Dixon & Wendt (2021)	Science	Self-Determination Theory (SDT)	To study the effect of the application of flipped classroom model towards high school students' motivation in learning science	Motivation among students increased when learning using the flipped classroom model.

The summaries in Table 2 show various fields of education in which FC was used and applied in the teaching and learning process at the secondary school or high school level. Some studies used specific learning approaches or learning strategies when implementing the FC environment, such as the 5E instructional model. There is a study that used specific measurements to indicate students' understandings in the FC environment. For example, Gariou-Papalexidou et al. (2017) used the taxonomy of Bloom as a measurement to indicate students' understandings. Gariou-Papalexidou et al. (2017) stated that the lower levels of the cognitive domain of Bloom, which are Remembering and Understanding, are achieved at home where students can study at their own pace. The higher levels of the cognitive domain of Bloom, which include Applying, Analysing, Evaluating and Creating, are achieved through the learning activities at school. The findings from the research studies resulted in the positive feedback of using the FC environment in education fields. The implementations of the FC were able to increase students' performances, attitudes, achievement, motivation, interest to study, increase teacher-student interaction, increase peer interaction, enhance creativity, and students learned actively during the teaching and learning process. Thus, the FC learning instruction can be widely used at secondary school or high school level based on its potential to the education system.

Review of Challenges of the Flipped Classroom

Although the use of the FC gives advantages when applied in the education field, teachers and students are still facing challenges during its implementation. Lo (2017) stated that it is more time-consuming for teachers because the teachers need to spend more time preparing the learning materials that will be used outside the classroom. The teachers also need to spend extra workload searching for useful related videos or recording suitable pre-class online videos (Lo, Lie & Hew, 2018). In addition, teachers found challenges to produce their own learning videos due to the lack of technical skills (Sarah & Yousif, 2016). Other than that, teachers faced challenges to ensure that their students watch the pre-class video at home because not all students are willing to watch the pre-class video due to the lack of pre-class motivation (Lo, Lie & Hew, 2018). Teachers also found problems in which the students disengaged when watching the learning video because the duration of the learning video is too long (Lo & Hew, 2017). As the impact, if not all students watching the pre-class video given by the teacher, the discussion process cannot be carried out effectively at school (Paristiowati et al., 2019). The discussion process at school is necessary because the teachers can clarify any misunderstood points regarding the pre-class video content and give feedback for the students' questions during the

discussion process (Sarah & Yousif, 2016). Thus, the student's motivation to participate in the FC should be taken into consideration. Gariou-Papalexiou et al. (2017) argued that the success of the FC environment occurs when students are motivated to participate actively in the learning process because teaching materials such as video outside the class itself are not enough for the effectiveness of the FC environment.

Lo, Lie & Hew (2018) revealed that although students repeatedly watched the pre-class videos, they still face difficulty in understanding the contents presented in the learning video. Thus, the teacher needs to re-teach those similar concepts that contain in the pre-class video by spending additional in-class time. In the FC, students must watch the pre-class video and learn the subject matter independently outside the classroom before they learn at school. Thus, students who need to learn directly with guidance from the teacher will face difficulties when learning in the FC environment (Paristiowati et al., 2019). Although there are other challenges regarding the external issues, such as the students' digital devices and socio-economic backgrounds, these factors are excluded as they fall into another scope of studies.

Recommendations for Future Studies

Based on the challenges of the implementation of the FC, several recommendations have been proposed by the previous scholars. The challenge due to the lack of students' motivation in watching the pre-class learning video can be overcome by providing the quizzes to motivate the student. Chuang, Weng & Chen (2018) reported that giving the quizzes to the students before the in-class session effectively increases students' learning motivation. The teacher can also provide the digital game elements in the quizzes to stimulate the students' interest to participate in FC learning. The elements in a digital game, such as badges and points, can increase students' motivation and engagement (Schmidt & Ralph, 2016). To attract students' interest in watching the pre-class video, the teachers need to ensure that they do not record the boring class lesson (Schmidt & Ralph, 2016). The challenges of students who faced difficulties understanding the learning video materials need to be taken into consideration. Teachers need to ensure that they are carefully designing the learning videos to get the students' engagement and understanding when watching the video (Lo & Hew, 2017).

Due to students' disengagement when watching the learning video because the duration of the learning video is too long, teachers need to ensure that the duration of the learning video is short (Bergmann & Sams, 2012). Lo & Hew (2017) proposed using 6 minutes videos to prevent students' from being reluctant to watch the learning videos. The challenges that are faced by teachers due to the lack of technical skills to produce their learning videos and the need to spend extra workload searching for useful related videos can be overcome by downloading the videos from widely available online video or media (Halimatus, Basuki & Hartati, 2018). However, teachers need to do a screening process before downloading the videos to ensure that the videos are suitable to be used as the source of learning (Halimatus, Basuki & Hartati, 2018).

Conclusion

The review of the research studies conducted in the various fields of education at secondary school or high school level shows that FC has the potential to be used and further developed in education fields. This is due to the advantages of the FC that can motivate students during learning processes, provide active learning, increase learning perception, increase learning engagement, enhance the knowledge, increase teacher-student interaction, increase peer interaction, enhance creativity and help to improve students' achievement and performance. The use of FC in education has also resulted in positive feedback from teachers and students in which they show their interest in using FC during the teaching and learning process. Positive feedbacks are essential in which it indicates the willingness of the teachers and students to engage in the FC environment actively. The FC environment provides a new learning experience to the students during the learning process outside and inside the class. However, the FC, which is relatively new in education, still encounters some challenges, such as the lack of students' motivation to watch the pre-class videos. Thus, the challenges should be overcome by using the recommendation proposed by the previous scholars, such as providing the quiz before the in-class time and integrating the game elements in the quizzes. The pre-class videos also need to be ensured that it is not too long to get students' engagement when watching the videos. All the challenges during the implementation of the FC need to be overcome to ensure that the research on the integration of the FC in education fields can be improved and implemented effectively in the future, especially at the secondary school or high school level. In conclusion, more studies on the integration of FC in the teaching and learning process at the secondary school

or high school level should be conducted in the future because of its benefits to the teachers and students. With the aid of FC, the learning environment can be enhanced by integrating technology during the teaching and learning process.

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