

The Influences of Flipped Classroom: A Meta Analysis

Approach every student capability in every class

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Abstract— The latest learning methods of 21st century emphasizes on student-centered learning and the use of technology in teaching. Flipped Classroom is one of the latest pedagogies that give attention to active learning through the use of technology as an intermediary in learning and teaching. In contrast to the traditional method where the teacher use 'chalk and talk', Flipped Classroom emphasizes on learning through the student's own knowledge construction. Thus, there are two-way interactions which are among the students themselves and between teachers and students. Existing traditional methods have experienced paradigm shift towards the implementation of the methods and patterns that meet the learning styles of students. Implementation of new methods, such as Flipped Classroom are to ensure balanced with the demands of the present century in education system. The main idea of Flipped Classroom is to give meaningful and impactful learning. Previous studies on Flipped Classroom found that this method has positive impacts on student's achievement. Previous researchers also have tested the effectiveness of Flipped Classroom from various aspects such as the use of different instruments for different discipline based on the level of their students. This paper will review a number of studies that have been carried out in assessing the participants after the implementation of Flipped Classroom approach.

Keywords—*Flipped Classroom; Student centered learning; Active learning; Education technology*

I. INTRODUCTION

In order to develop the education system tandem with the changing world of international education, teaching methods should meet the quality of student's learning. Thus, a variety of teaching methods must go together with students' learning styles.

Flipped Classroom is a pedagogical method which incorporates the use of technology in learning and teaching process. Flipped Classroom also stressed on student-centered learning activities and emphasizes on self-paced learning. Besides, this method is also able to provide opportunities and support to students in preparing learning under their own abilities as well as learn to solve their own problems through the guidance of a teacher and friends who are more competent. Thus, taking into account the teaching approach that is feasible is of reasonable and necessary to help improve students' achievement. One of the teaching methods that has been empirically proved its effectiveness is Flipped Classroom.

Flipped Classroom is originally implemented at the university level in the fields of technology before it has been used widely in schools in Science, Technology, Engineering and Mathematics (STEM) [1, 2]. Does this mean that the Flipped Classroom is suitable to be applied in various fields especially in the field of education? This paper will clarify and answer the question whether Flipped Classroom can be implemented in a variety of disciplines, including the types of instruments used to test the effectiveness of the Flipped Classroom.

II. DISCUSSION ON SELECTED PAPER

Previous studies on Flipped Classroom derived through journal articles from electronic databases such as IEEE, Springer, SAGE Journals, JSTOR and ProQuest. Journal articles that have been obtained were from 2009 to 2014. A total of 15 articles were selected based on the level of education, samples and field, as shown in Table 1. The articles were selected according to different levels of participation at university and school level. In addition, this review also focused on student's achievement in terms of methods and

different disciplines. Reviews will start with a brief explanation of each article derived. The explanation is based on the instruments used in each study. The author will also list some potential gap to be filled in based on previous studies, which is shown in Table 1.

TABLE I. LIST OF PUBLISHED RESEARCHES ON FLIPPED CLASSROOM APPROACH

| Author (s) | Participants Level | Instruments(s) | Discipline(s) |
|------------|--------------------|--|--|
| [3] | University | Survey on perception Interview and Questionnaire | Science |
| [4] | School | Curriculum development | Mathematics Science Social Science English |
| [5] | School | Assessment | Mathematics |
| [6] | University | Observation Questionnaire | Engineering |
| [7] | University | Survey Evaluation Observation | Mathematics Technology |
| [8] | University | Observation Assessment Survey | Engineering |
| [9] | School | Observation | Technology |
| [10] | University | Field notes Observation Interview Assessment | Mathematics |
| [11] | School | Anecdote Assessment | Science |
| [12] | University | Survey Assessment | Science |
| [13] | University | Survey Pre and post test | Engineering Technology |
| [14] | University | Perception Case study Assessment | General |
| [15] | University | Assessment | General |
| [16] | University | Survey | Technology |
| [17] | University | Observation | Medical Science Social science Business Management |

A. Brief Explanations of Each Study

Study on a group of university students in science subjects by [3] found that the Flipped Classroom, which was introduced for the first time had a positive reactions among the students. Based on the questions derived from responses

received, 70% of the students stated that they have been benefited by learning through group activities and discussions in Flipped Classroom compared to the conventional method where they attend classes and receive information passively.

According to [4], a different approach, from the point of changes in school curriculum should take place, to ensure that the school curriculum moves in tandem with 21st century learning. [4] argues that curriculum needs the brave changes and research on teaching and learning must be done continuously. This finding is also supported by [4] for the implementation of new methods, such as an ongoing Flipped Classroom. The study also showed an increase in the percentage of students who passed in Mathematics, Science, English and Social Sciences papers after implementing Flipped Classroom [4].

The use of technology in the Flipped Classroom has a positive impact on the education system. The use of technology appropriately and systematically not only help teachers in teaching but also help students to understand tough subjects [18]. In addition, it is proven that the use of technology has helped in terms of reducing the cost. This statement was made based on a study conducted by [5] in one of the schools in the United States, namely Bryon School. Bryon School has experienced severe financial problems and the school had to make drastic changes to the school curriculum. Therefore, unable to bear the cost of purchasing textbooks, Bryon School has implemented Flipped Classroom as an alternative to replace the conventional method. The aim was to replace the ordinary textbooks to digital textbooks consistent with the concept of Flipped Classroom. All reference materials such as digital textbooks can only be accessed through the internet. Mathematics subject was used as a pioneer in implementation of the Flipped Classroom. The school performed extremely impressive and in 2011, the school was awarded for *School of Distinction for Mathematics* by Intel. As a result, Flipped Classroom method has been implemented widely by other schools and Bryon School has been referenced by other schools who are interested to learn Flipped Classroom.

Implementation of new pedagogical methods such as Flipped Classroom needs a brief explanation of the implementation procedure to the students. Students should be given an explanation of Flipped Classroom before implementation starts in order to avoid any unpleasant feelings and emotions among students. In addition, explanation about Flipped Classroom before the implementation process can also prepare students to accept a new approach. The study by [6] from Singapore focused on learning output. [6] found that Flipped Classroom received positive response from the students and the learning output achieved as expected.

Based on Table 1 most researchers focus on students' achievement and the effectiveness of the Flipped Classroom. [7] have made a difference by combining Flipped Classroom with inquiry-based learning pedagogical methods. The combination of Flipped Classroom and inquiry-based learning methods has been implemented to ensure that students have more opportunities through group activities, hands-on and in a systematic way. The authors found that this combination

triggered to ensure student engagement occurs and can give attention to class activities. Effective impact of the study is encouraging and [7] tried to build his own digital materials and expand the implementation of the Flipped Classroom to other disciplines.

[8] focused on the content and found that, the students can cater more content in that subject. The students who are taught through Flipped Classroom are also capable of solving more high-level questions compared to students from conventional classes.

Flipped Classroom is a flexible method which can be implemented in a variety of disciplines and levels of education. [9] proved that the Flipped Classroom at school is not limited to main stream students but has the potential to be implemented for gifted and special needs students. The study by [9] proved that Flipped Classroom is not limited to any specified class of students. If students have problems in education, Flipped Classroom can help these students to improve their motivation and interest. Self-paced learning in Flipped Classroom helps and acts as the recovery process because students are able to repeat their learning according to their own abilities. In contrast, for students with high intelligence, the Flipped Classroom acts as enrichment activities for gifted students to generate ideas [9].

The technology used in teaching is meaningful to students, especially if the student is smart, in manipulating technology for learning purposes. The technologies used in Flipped Classroom are video, audio, multimedia software and smart learning system. Intelligent Tutoring System is the online system used by [10] in implementation of Flipped Classroom. [10] emphasizes interactive learning, such as online learning is to be implemented together to ensure that the objectives are achieved. The opinion of [10] opposite with [19] who stated Flipped Classroom methods do not necessarily rely on online learning, but can use any kind of material as long as it benefits the students. However, from another point of disagreement is an opportunity for other researchers to expand the scope of research on Flipped Classroom methods of various dimensions.

Flipped Classroom gained attention when [11] uses technology Vodcast and Podcast in implementation of Flipped Classroom. [11] are two science teachers who teach chemistry at a high school in Colorado. The idea of implementation of Flipped Classroom began when [11] found that students have trouble in completing homework outside of school hours. [11] also found that teachers have a problem to reteach lessons for students who did not attend school. This situation reduces the time available for teachers to repeat any of the topics that the students missed or not understood before teaching a new topic. [11] stated that using technology such as Vodcast and Podcast allow access to teaching materials through ipod and video on the internet. This will give students an opportunity to learn about topics that are taught outside of school hours if they are unable attend school for various reasons. Other students are also using the same methods that manipulate digital materials outside school hours. As a time of teaching and learning in schools can be utilized optimally and activities in the classroom could be devoted to activities such as group

activities, laboratory activities, demonstrations, hands-on and debate.

Based on inspiration from the study [11], it is used to measure the effectiveness of the Flipped Classroom in terms of students' achievement, the average attendance and students' behavior. While the findings show a positive impact, [12] found a significant advantage of Flipped Classroom which is it provides space and more quality time between teachers and students. Interaction between students and teachers is the key to active learning and meaningful. Meaningful learning for students is when they are able to gain much time to learn than being taught.

[13] conducted a study at a university for a group of first-year students through the pre and post test surveys together. [13] found that a group of students who were taught using the Flipped Classroom has obtained a high percentage score. Student's achievement in Flipped Classroom showed highly significant differences compared to conventional method. The positive impacts of these preliminary findings are made by [13] due to intends to extend the implementation of the Flipped Classroom for other subjects.

Since the Flipped Classroom is one of the new pedagogical methods, [14] have developed a concept map to facilitate the implementation of the Flipped Classroom method. By using the concept map, students can learn subjects taught more easily because the concept map helps students understand in-depth by visual diagrams. Learning occurs through self-paced learning while teachers assisted in terms of overview of the topic to be taught in the Flipped Classroom using a developed concept map.

A study conducted by [15] is based on a comparison between the performances of Flipped Classroom with existing traditional methods in a university. [15] has combined team-based learning through Flipped Classroom version 2 [15] expects combination of Flipped Classroom and team-based learning can enhance active learning in blended learning environments.

[16] implemented Flipped Classroom while teaching Graph and Image Processing subjects, one of the universities elective subjects. This subject was chosen because according to students, Graph and Image Processing subjects are the most difficult subjects. Flipped Classroom was chosen as the method to teach Graph and Image Processing to determine whether this method can give a positive impact. The results showed that the implementation of the Flipped Classroom can help students understand difficult subjects easier. Moreover, the implementation of the Flipped Classroom allows students to submit more questions that they did not understand to lecturers.

[17] conducted a study to explore the relationship between students' attitudes and the implementation of the Flipped Classroom. Based on the concept of Flipped Classroom, students will be given material to learn before the teaching and learning take place. This is the initial exposure to what will be taught. The study by [17] found that university students are less active when the lecture was actually caused by the formation of learning starting from the school level. Teacher-

centered teaching at school has become a culture that is difficult to change. Thus, in the opinion of the author, pedagogical modifications need to be done starting from the school. This is consistent with the recommendation by [4] that the brave reforms should be carried out on conventional method. [17] also looking for the relationship between learning styles and teaching techniques. The study by [17] also proved that the learning styles of students must be in line with the teaching techniques which can be adapted in the Flipped Classroom. Nevertheless Flipped Classroom is the best platform for teachers to improve their skill and creativity during the teaching.

B. Instruments

Based on previous studies, a variety of instruments used to measure the dimensions of the relevant studies on Flipped Classroom. The instrument chosen was based on the research objectives and the suitability of the sample. Due to Flipped Classroom method is one of the latest and highly contrasts with the conventional method, then [3] and [14] see the needs to measure the effectiveness of the method based on the perception of respondent Flipped Classroom. [3] measured the effectiveness of the Flipped Classroom method based on two surveys. The first survey is to examine students' learning styles which can be beneficial to them. The results show that students prefer learning through group activities, as stressed in the Flipped Classroom. The second survey by [3] also found that students prefer learning on their own compared to learning through lectures, tutorials or group learning. Self-Learning is as emphasized by Flipped Classroom method in the first phase to be able to provide space for students to learn in a self-paced.

[14] measured the effectiveness of the Flipped Classroom to get feedback on the concept map developed of their own. Concept map that helps students understand something as a whole [14].

Interview is one of the instruments used by researchers to gain a more in-depth data. Some researchers were using instruments interview [3, 10]. Other researchers [6] to get the data through the distribution of closed-ended questions to get feedback from the respondent in large quantities, [3, 10] conducted interviews with a small quantity. However, the data obtained by [3] and [10] are more in-depth because the instrument chosen was interview based from open-ended questions.

One of the instruments that is most widely used by researchers to identify the effectiveness of the Flipped Classroom is assessment as conducted by [5, 8, 10, 12, 14, 15]. Assessment is carried out in the form of formative, summative, or both. From all the researches, findings show that assessment was carried out to prove that a drastic increase in the percentage.

Observation is one of the instruments that has been chosen by some researchers such as [6, 7, 9, 10, 17]. Selection of instruments for observation is to observe the behavior of the respondents when teaching session is conducted through

Flipped Classroom. Through observation, more natural behaviors can be obtained and can be interpreted holistically.

Generally, there are researchers who choose one type of instrument and there are also researchers who chose more than one instrument depends on the objectives of the study and research respondent. However, the entire selection instrument is intended to examine the effectiveness of the implementation of the Flipped Classroom.

C. Disciplines

Table 1 shows that the Flipped Classroom is very flexible and can be implemented in a variety of disciplines. Flipped Classroom first applied in the field of technology by Flipped Classroom pioneer [20, 21]. Later, Flipped Classroom method was integrated into a variety of disciplines such as Science, Technology, Engineering and Mathematics (STEM). In addition to Social Science, Flipped Classroom has also been used in the Medical field [17]. While Flipped Classroom can be implemented in a variety of disciplines and also appears to be examined in a variety of different levels of education either at university or school.

D. Future Studies

Overall based on the studies described in Table 1, there are still some gaps to be filled in the survey, especially when it involves the study of new pedagogical like Flipped Classroom. The gap can be seen is the implementation of the Flipped Classroom that should emphasize students' learning styles. From all the studies, there was only one researcher who studied the relationship of learning styles to Flipped Classroom [17]. The Flipped Classroom also is implemented at the school level as students learning patterns must be formed from the school level as recommended by [17]. Activities in the classroom should be emphasized to ensure student engagement occurs. The study that focused on class activity is very few, as was done through the study [7, 11, 15]. Continuous assessment should also be done to ensure successful implementation of the Flipped Classroom.

III. CONCLUSION

Based on the findings shown in Table 1, it can be concluded that the Flipped Classroom gave a positive impact on students' achievement. Flipped Classroom has been seen fit to be integrated into a variety of disciplines such as Mathematics, Science, Engineering, Technology and Social Sciences. The Flipped Classroom is also suitable to be implemented in schools and institutions of higher learning. However, from all 15 studies, studies which emphasize activity in the classroom are very less. Based from the reason of Flipped Classroom studies are still limited, most researchers focus on the effectiveness of implementation of the Flipped Classroom. Flipped Classroom study which focuses on activities in the classroom need to be explored [3, 4, 22]. The authors intend to conduct research related to Flipped Classroom at secondary

level since the implementation of the Flipped Classroom provides significant implications for the curriculum. The use of technology in the Flipped Classroom is also in line with 21st century learning, which emphasizes on the use of technology in education. Existing conventional teaching methods need to be changed in order to ensure that the education system is moving in tandem century learning. Flipped Classroom is seen between the methods and the realization of potential research continues to be done, especially on the study of teaching.

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