

Project Based Learning in Flipped Classroom Based on Student's Cognitive Style

Hasnah Mohamed, Aminabibi Saidalvi, Nor Azneza Tashiron

Abstract—Flipped classroom and project-based learning have gained the attention of many researchers and practitioners in education. Despite proven effective empirically, very few studies have emphasized project-based learning in flipped classroom based on students' cognitive style. Thus, the purpose of this study is to investigate the effectiveness of project-based learning in flipped classroom based on students' cognitive style. This study adopted randomized pretest-posttest control-group quantitative research design. The instruments used in this study were Group Embedded Figure Test (GEFT), Pretest and Posttest. A total of 72 students were involved in this study. Data were analyzed by percentage, mean, and correlation of Eta. The findings show that the majority of Year 5 students have Field Independent (FI) cognitive style. Pretest and posttest analysis show project-based learning approach in flipped classroom can help improve students' achievement in Mathematics and benefit both Field Independent and Field Dependent students.

Index terms—flipped classroom, project based learning, cognitive styles, Field Independent (FI), Field Dependent (FD), Group Embedded Figure Test (GEFT)

I. INTRODUCTION

The current generation of students who are heavily exposed to technology is an opportunity for researchers and practitioners of education to diversify the methods, approaches and techniques of knowledge delivery. The emergence of flipped classroom, a new pedagogical method has recently being carried out in various learning disciplines and studies [1],[2],[3] mostly show positive over the negative impact.

Flipped classroom encourages more innovative learning since it allows instructors to use various types of media to convey information to students. For example, the inclusion of videos, notes in e-learning, and voice recording help students to gain early understanding of a concept. The studies conducted by [4] and [5] show that flipped classroom approach really helps students improve their understanding of a concept or subject.

Besides, linking flipped classrooms to another important pedagogy, project-based learning will definitely postulate a new learning situation to students. Project based learning is one of the common active learning methods practiced in the technical, science and mathematics subject sit is a method

that emphasizes student-centered learning and gives students the opportunity to improve their problem-solving, creativity and team working skills.

However, the implementation of flipped classrooms with project-based learning activities should be parallel to the students' cognitive styles or learning styles so that the learning approaches can benefit them, especially to the weak students. Cognitive style is one of the most important elements that should be taken into account in planning learning and teaching methods especially when it involves technology [6]. Therefore, this study investigates the efficacy of using project-based learning in a flipped classroom based on cognitive styles of the students.

II. REVIEW OF LITERATURE

In the 21st century it is important for teachers to recognize the importance of using various media and teaching methods to keep up with the needs and time. One of the most appropriate approaches practiced in realizing educational transformation is flipped classroom. Flipped Classroom founder [1] has been implementing flipped classroom as a teaching approach to find some innovations in education. Flipped classroom changes the role and task of teachers to facilitators and learning situations to student-centered learning by improving communication skills with colleagues in the classroom. Many studies [2], [3], [4], [5], [6],[7],[8] which emphasize the effectiveness of flipped classroom approaches to students have been conducted. Referring to [9] in his study, showed a low level of stress in an environment that used flipped classroom compared to other classes. [10] in studies at American schools found that there was an increase in engagement among teachers and students when using flipped classroom methods. The use of flipped classroom also reduces the percentage of students who are unprepared before entering the class room. A flipped class room approach that requires students to study the material provided by the teacher before entering the classroom allows the student to get an early introduction on the teaching topic on that day as well as to understand the key concepts of the topic. Students who have experienced flipped classroom give positive response where they enjoy the use of flipped classroom approach in their learning [7]. The students found that they had the opportunity to communicate with classmates, completing homework in class and engaging in meaningful activities.

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Research [7] is parallel with research by [11] that found the use of this approach can improve the times of face to face meetings between students and teachers and a meeting between a student and a teacher. Meanwhile, a study by [12] on trainee teachers found that they were satisfied with the flipped classroom approach introduced. They also found that this approach allowed students to learn flexibly and autonomously. Activity in class is an element that is very much loved by students when using the flipped classroom approach [13]. This is gathered by [13] in his study through an interview with the students after using the approach. The results proved that choosing proper video with relevant classroom activities and the opportunity to work with others is a positive opportunity to improve students' learning. Students said that they got two values in lecture videos: the opportunity to build a conceptual understanding; and opportunities to access and learn at their own pace. This approach also helps students with different learning styles. Meanwhile, [14] found that there was a significant difference in learning outcomes between teaching using flipped classroom approach and teaching using lecture methods. Students who learn using flipped approaches obtained higher marks than students who were taught using lectures. In conclusion, the use of flipped classroom was able to provide a lot of benefits to both students and teachers. In addition, it can increase teacher time with students.

In addition to flipped classroom, project-based learning is also an increasingly popular approach among educators and researchers. Project-based learning has proven its effectiveness in enhancing high-level thinking skills and problem solving skills [15]. Project-based learning is one of the most appropriate approaches for low achievers. Group activities will help them improve their skills in solving problems and also understanding a concept [16]. The studies conducted by [17],[18],[19],[20] show positive impact of project-based learning. [18] in his study found that students' using project-based learning enabled them to have positive experiences when communicating, interacting and discussing among themselves. Besides, through discussions they can improve critical thinking skills; a vital competency in computational biology [18]. The study conducted by [21] found that PBL is an effective teaching method that can motivate and inspire students to learn when they are involved in a project.[22] through his study revealed that PBL improves professional skills in students and concludes that project-based learning methods can have more impact compared with traditional types of education and training. Study by [20] show that PBL approaches are equally effective for students with varying depths of mathematical knowledge. In addition, the implementation of the PBL approach increases the motivation of learning among students.[23] in his study on interdisciplinary projects in English for information science courses to encourage students to link language skills to their content knowledge. As a result of this study, he found that project-based activities created a balance between language skills, knowledge of science information and technology information skills in their projects. It can be concluded that the use of project-based learning provides a positive impact on improving problem solving skills, communication, collaboration, cooperative and self-confidence. Therefore,

the use of project-based learning should be expanded so that more students and teachers will benefit.

In terms of psychology, each individual has its own learning style. One of the styles that should be considered in designing and teaching is cognitive style. Cognitive styles are something that exists in an individual since they were born. The cognitive style refers to the way one chooses to process information. Cognitive style is usually described as a personality dimension which influences attitudes, values, and social interaction. The studies conducted by [24],[25],[26] show the importance of cognitive styles in developing learning and teaching. Hence, the combination of both methods and the cognitive style factor should have a better impact on the achievement of students in a particular skill. A study conducted by [27] on students of Zamfara State College of Education Maru, Nigeria found that there was a significant relationship between the female and male students and between the Field Independent (FI) and Field Dependent (FD) cognitive style on their academic achievement. The study also revealed that FI and FD cognitive styles are significant predictors of the scientific achievements of biological students at that university. In addition, a study conducted by [28] on the impression of cognitive style of FI and FD and motivational style towards conceptual understanding on the concept of direct circuit. The results showed that there were significant differences in the mean score of the students of the FD and FI cognitive styles. There is also a significant difference in the mean score of social motivated students with conscientious and achiever students.

Based on the above discussion, it is clear that past studies have shown positive effects of project-based learning and flipped classroom on students' achievement. Therefore, both approaches should be combined to help improve students' attainment. Furthermore, the importance of cognitive style in education studies is undeniable as everyone has different cognitive styles which influences their progress in learning.

III. OBJECTIVES

The objective of this study was to examine the effectiveness of project-based learning in the flipped classroom based on cognitive styles of students in mathematics.

IV. METHODOLOGY

This study involved purposeful sampling of 72 students from Year 5. Students are randomly divided into 2 groups; treatment group and control group. The treatment group which consisted of 34 students experience project-based learning in a flipped classroom setting while the control group with 38 students used the traditional learning method. Three types of instruments were used, namely Group Embedded Figure Test (GEFT), Pre-test and Posttest.

GEFT is used to find the types of students' cognitive styles while the pre-test and post-test were used to see the effectiveness of project-based learning in flipped classroom to enhance students' skills in mathematical subjects. In this

study the cognitive style, Field Independent (FI) and Field Dependent (FD) was measured. This is because both of these styles are often connected to education. Both pre and post-test have high Cronbach Alpha value. Cronbach Alpha values for pre and post-test were recorded as 0.743 and 0.819.

V. RESULTS

The findings of this study are presented in two parts. The first part is the results of GEFT analysis on the cognitive style of the students and the second part is the impact of project-based learning in the flipped classroom. Figure 1 presents the number of students based on cognitive styles and groups.

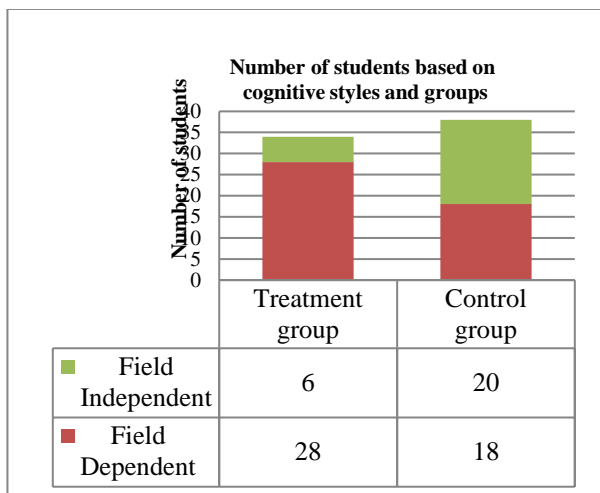


Figure 1: Number of Students Based on Cognitive Styles and Groups

It was noted from Figure 1 above that there are 18 FD students and 20 FI students from the control group while the treatment group recorded 28 students from the FD and only 6 from the FI group. Table 1 presents the achievement of students for both the control and treatment group in the pre and post-test based on cognitive style.

Table 1: Pre and Post-Test Result for Control and Treatment Group Based on the Cognitive Style

Group	Cognitive styles	Number of students	Mean score	
			Pre	Post
Control (38 students)	FI	18	2.20	4.65
	FD	20	2.50	5.00
Mean			2.34	4.82
Mean value difference			+ 2.48	
Treatment (34 students)	FI	28	4.67	16.67
	FD	6	3.57	16.61
Mean			3.76	16.62
Mean value difference			+ 12.86	

Based on Table 1, it can be highlighted that there is a mean difference between the pre-test and the post-test for both the FD and FI students in the control group. The mean score for the pre-test of the FI students is 2.20 and increase to 4.65 in the post-test. While in the control group, FD students

recorded a mean of 2.20 in the pre-test and increased to 4.65 in the post-test. Thus, it can be stated that there is a significant mean difference for the control group in both the pre and post-test for FD cognitive style groups and FI cognitive styles groups.

Meanwhile for the treatment group, it was noted that the FI students recorded a mean score of 4.67 in the pre-test and plummeted to 16.67 in the post-test. Similarly, the FD students in the treatment group leaped high from 3.57 in the pre-test to 16.61 in the post-test. Besides, it was found that a significant increase of +12.86 was recorded for the treatment group compared to only +2.48 for the control group. This finding clearly highlights that both cognitive style groups in the treatment group achieved better performance than the counterparts in the control group. It can be concluded that project-based learning approach in flipped classroom has a great impact on teaching and learning Mathematics compared to traditional approaches.

In addition, there is a significant achievement difference between students who have the cognitive style of FI and FD. Hence, to see the relationship between cognitive style and students' achievement, ETA analysis has been conducted. The result shows that there is a moderate relationship between cognitive style and students' achievement. The correlation analysis of ETA shows the value of 0.589 (Eta Squared = 0.347). According to Cohen (1992), there is a moderate relationship between two variables when the value of ETA is between the ranges of 0.0 to 0.5.

VI. DISCUSSION

Based on the analysis, it can be concluded that project-based learning approach in flipped classroom based on cognitive style has a great impact on students' achievement. There is a significant relationship between FD and FI cognitive style and students' achievement.

Thus, the conclusions of this study are as follows:

- a. There is a relationship between FD and FI cognitive style with students' achievement.
- b. There is a significant difference of achievement between the treatment group and the control group
- c. There is more improvement among the FD students than the FI students using project-based learning in flipped classroom during teaching and learning.

The findings show that project-based learning in flipped classroom provides benefits to both groups of cognitive styles, especially FD students.

Although it is evident from many studies that flipped classroom practice and project-based learning often has a positive impact on students, the learning process will be difficult if the teaching does not fit the student learning style [29] Classroom facilitators need to think creatively and critically about teaching content, activities to suit the

cognitive style of the students.

The findings of this study are in parallel with the studies conducted by [15], [17],[18],[19],[20],[22] that found project based learning has a positive impact on learning and teaching. In addition, in flipped classroom study, the results of this study are in line with the studies conducted by [2], [3], [4], [5], [6],[7],[8], [9], which also has a positive impact on student achievement.

Therefore, the findings of this study have supported the findings of existing studies, but this study has also proven that the combination of project based learning and flipped classroom is a good approach. Hence, it is proposed that more studies be conducted to see the effectiveness of the combination of these two approaches in other subjects.

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