



Using Flipped Classroom Model to Enhance the Junior High School Students' Achievement and Engagement in Algebra

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Article Info	Abstract
Received August 10, 2022	This study examines whether using flipped classroom model could enhance junior high school students' achievement and engagement in algebra. A quasi-experimental design which is a switching replication model with posttest only is used in this study to determine whether the students' achievement in the experimental group (using flipped classroom model) differs from the control group (using traditional classroom model). A questionnaire is used to evaluate the students' engagement during the lessons in the experimental group, and the results then are presented in the descriptive statistics. The result of this study is that the experimental group has significantly (p -value=0.001) higher gain mean scores ($M=61.54$, $SD=20.49$) than those in the control group ($M=55.63$, $SD=23.76$). It describes that students in the experimental group have better achievement than the students in the traditional classroom. This study also shows that the students in the experimental group agree that they are more engaged and active during the lesson, with the mean of the items engagement being more than 3,7 ($3.72 \leq M \leq 4.19$). The correlations between the engagement items and the posttest from flipped classroom show positive, moderately strong correlations. Thus, this study sheds light on flipped classroom models as one of the great teaching models nowadays.
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INTRODUCTION

The rapid growth of science and technology has caused changes to mathematics curricula, which now focus more on developing the students' critical thinking and reasoning. Furthermore, these curricula should also provide a learning environment that attracts students to more engage in the lesson, and provide opportunity for students to improve their skill of using technology. According to Bloom's Taxonomy, there are six levels of students' thinking, which are remembering, understanding, applying, analyzing, evaluating, and creating (Prismana, Kusmayadi, & Pramudya, 2018). The focus of current mathematics curricula is how to bring students to achieve at least level 3 on the Bloom's Taxonomy above. In order to get this level, students need meaningful lessons and enough time to process their understanding.

Flipped classroom model may be the answer for this situation. It is a new instructional model in teaching which presents lectures as homework to be completed outside of class using online video, while the class time is used for engaging students with the materials (Gaughan, 2014). Flipped classroom model requires students to learn the material content before class which will create space during class for learning opportunities where students can discuss, and apply their knowledge to deepen their understanding (Wallace et al., 2014).

We select algebra for this study because it is an essential part of mathematics, and the contents of algebra are structured. This means that students should master the previous contents before moving to the next contents. In other words, it is very important to deepen junior high school students' understanding in algebra because it will be the basis for the high school algebra. Furthermore, the contents are usually represented by symbols that are abstract. For the junior high school students, it is challenging to understand the abstract concepts. When students struggle to understand the abstract concepts, they will lose their focus to the lesson. They will not be interested to study mathematics anymore. In other words, they will not engage curiously in the lesson.

To help students gain the abstract concepts, and to make them actively involved in the lesson, they need appropriate instructional models that provide them more time to engage in the lesson in order to build their understanding in these concepts. Flipped classroom model may be one of the proper instructional models in this case. This study may provide useful information for teachers especially for the junior high school mathematics teachers. Therefore, the purpose of this present study is to investigate whether using flipped classroom model could enhance the junior high school students' achievement and engagement in algebra.

Literature Review

In 2007, Bergmann and Sams (2012; 2013) were the first teachers who used flipped teaching at a high school level. They recorded their lectures to help their students who missed the class. In the flipped classroom model, teachers' positions are the guides or facilitators who encourage the students to become active learners (Bennett et al., 2012).

Many studies were conducted to analyze the effects of using this model in students' attitude, engagement and achievement. Jamaludin and Osman (2014) found that flipped classroom models enhanced students' engagements in undergraduate TESOL students.

Strayer, Hart, and Bleiler (2015) found that flipped classroom models helped instructors/teachers to identify the gaps of students' understanding or misconceptions to the mathematical concepts before the class. This information eased the teachers to address the errors during the class sessions. It increases comprehension of students' thinking that helps students to make sense in the mathematical problems. They described that flipped classroom model enhanced students' reflection and elicited responses from other students. In addition, students were able to develop new knowledge using this model.

Kirvan, Rakes, and Zamara (2015) examined the effect of flipped classroom model in students' conceptual understanding and improving learning outcome in linear equations system topic. They found that flipped classroom models provided more time for exploration and enrichment activities, but more focus on the

substance of the videos and class activities were needed to increase students' conceptual understanding. Although they found that there were similar levels of achievement growth in both groups, students in the flipped classroom model showed greater improvement in their ability to solve systems of linear equations than the control group.

A study conducted by Clark (2015) examined the effects of using the flipped classroom model on students' engagement and performance in algebra in a secondary school. He found that this model could significantly improve the students' engagement compare to the traditional model. However, this study did not find the significant difference in the students' achievement between the treatment group and the control group.

Another study conducted by Ogden (2015) investigated the student perceptions of the flipped classroom in college algebra. He noted some findings in this study. First, students felt that they had more time to discuss the topic with their lecture or friends. Second, students felt that this model provided multiple instructions that supported their needs. Third, they could learn the topic at their own pace. With these findings he thought that this model would also have a positive impact on the students' achievement. Therefore, he suggested that the future research should evaluate the use of flipped classroom models in students' achievement.

The suggestions from Ogden's study (2015) are the references for this current study. So, there are two teaching models, that are flipped and traditional classroom model. The focus analyzes of this study will be on the students' achievement and engagement. Therefore, this current study will investigate whether using flipped classroom model could increase the junior high school students' achievement and engagement in algebra.

This study will address two research questions: (1) Is the students' achievement in the flipped classroom model better than the traditional model?, (2) Does the flipped classroom model have more impact in the students' engagement than the traditional classroom?

Regarding these research questions, the hypotheses in this study are as follows: (1) the students' achievement in the flipped classroom model is better than the students' achievement in the traditional model, (2) the flipped classroom model has more impact on the students' engagement than the traditional classroom model.

RESEARCH METHODS

The design of this study will be the quasi-experimental design which is an experimental design that has the same purposes and structures to true experiment, but it lacks random assignment of the units (Shadish, Cook, & Campbell, 2002). The design model is the switching replication with posttest only. There are four classes in this study which are 9A, 9B, 9C and 9D. Two classes (9A and 9B) become the first group (NR_1) and another two classes (9C and 9D) become the second group (NR_2). In the first duration, the first group (NR_1) becomes the experimental group, while the second group (NR_2) becomes the control group. The experimental group (NR_1) gets the treatment which is flipped classroom model (X) while the control group (NR_2) gets the traditional classroom model. Both groups learn the same topic which is exponents. After two weeks, both groups take the first posttest (O_1) to

measure the students' achievements. In addition, the treatment group (NR₁) also take the survey (questionnaire) to measure the students' engagement.

In the second duration, the groups are switched—NR₁ becomes the control group and NR₂ becomes the treatment group. Both groups still continue to learn the exponents topic, especially about roots. After two weeks, both groups then take the second posttest (O₂) and the treatment group (NR₂) also take the same survey. The design is diagrammed as the Table 1.

Table 1: Experimental Model

Research Group	Treatment	Posttest 1	Treatment	Posttest 2
NR ₁	X	O ₁	-	O ₂
NR ₂	-	O ₁	X	O ₂

The independent variable in this study is the teaching classroom models that consists of two models – the flipped classroom model, and the traditional classroom model. The dependent variables are students' achievement and engagement. The participants in this study are 91 students from 4 classrooms of 9th grade on Public Junior High School at Sentani Jayapura.

Instruments

The posttest is used to determine whether the students in flipped classroom model could perform better than the students in the traditional classroom model in their achievement. The posttest model is 25 multiple-choice questions with three confounding and one correct answer.

A questionnaire is used to measure the students' engagement. The questionnaire is based on Reeve and Tseng (2011) which consist of a 5-point Likert scale that ranges from 1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, to 5=strongly agree. This questionnaire includes five items of behavioral engagement, seven items of agentic engagement, four items of cognitive engagement, and five items of emotional engagement. This questionnaire has been assessed the inter-item consistency reliability. The Cronbach's alpha values were above of 0.95 (Jamaludin & Osman 2015). Thus, these instruments have high reliability measure. However, this study does not use all the items, only 2 items from each part of engagements are used. So, the total items are 8 which are: 1) During class, I ask questions, 2) During class, I express my preferences and opinions, 3) I pay attention in the class, 4) I try very hard in the class, 5) I enjoy learning new things in class, 6) When I am in class, I feel curious about what we are learning, 7) When I am in class, I feel curious about what we are learning, 8) I make up my own examples to help me understand the important concepts I study.

Procedure

This study is conducted at Public Junior High School, Sentani, Jayapura regency, Papua in August 2019. It is implemented over two weeks in the first duration and another two weeks for the second duration to the 91 9th grade students in the topics of algebra. The duration of each lesson is 2×40 minutes twice a week, and the schedules is depend on the schools' schedules.

The process of this study is as follows: the students in the experimental group prepare for class by watching videos the night prior the class. For example, if the

next day's schedule is for flipped classroom, they will prepare the class by watching the video lessons, however if the schedule for the next day is traditional classroom, they will do their homework from the past lesson. During the class time, in the experimental group: the teacher starts the class by checking whether the students already watched the video or not, and then the students do many activities to deepen their understanding, such as discussing the difficult video's contents, doing hand-on-activities, and doing exercises. In this time, the students engage the lessons actively, while the teacher become their facilitator. In the control group: during the class time, the students do the same activities as the experimental group except disusing the video lesson. In addition, the deep of the subject materials in this group depend on the time. After the lesson, teacher gives them homework.

The lesson videos are uploaded on YouTube a day prior to the lessons, and the links are shared in the students' WhatsApp group. For those students who do not have internet access, the videos are sent using Bluetooth or copied into flash disk.

The data from two posttests then is analyzed using paired samples *t*-test. This analyzed determine whether the two groups have difference students' achievement. In other word, do students in the experimental group have better achievement than students in the control group. The data from the survey questionnaire is also analyzed to determine how high students' engagement in the flipped classroom model.

RESULT AND DISCUSSION

Students' Achievement Data Analysis

The descriptive statistics are used to compare the means, the standard deviations, the maximum and minimum scores from two groups. The results is as in Table 2.

Table 2. Descriptive Statistics for Data Test		
	Trad. class	Flipped class
Mean	55.63	61.54
Standard Deviation	23.76	20.49
Minimum	20.00	32.00
Maximum	96.00	100.00

Table 2 shows that number of participants is $N=91$ students and all of them are valid. The mean score in the flipped classroom model ($M=61.54$, $SD=23.76$) is higher than the mean score in the traditional classroom model ($M=55.63$, $SD=20.49$). In addition, the minimum score (min=32) in the flipped classroom model is also better than the minimum score in the traditional classroom model (min=20). The maximum score students' achievement by using flipped classroom model is 100 and the traditional classroom model is 96.

A paired samples *t*-test is run to evaluate the difference of the means students' achievement between the two groups, and whether this difference is significant or not as in the Table 2.

From the Table 2, we see that the students in the experimental group have significantly higher gain scores ($M=61.54$, $SD=20.49$) than those in the control group ($M=55.63$, $SD=23.76$). Moreover, the paired samples *t*-test indicates that *t* value for *df* 90 is significant (*p*-value=0.001). Thus, the null hypothesis that the

experimental and the control group have the same mean gain scores is rejected. Therefore, the students in the flipped classroom perform better than to the students in the traditional classroom in their achievement. Since this finding, flipped classroom could be considered as a good classroom model.

Tabel 2. Paired Samples Test Analysis

Learning model	Mean difference	<i>t</i>	<i>df</i>	<i>Sig.</i>	Conclusion
Flipped classroom Traditional classroom	5.912	-3.895	90	0.000	Significant difference

This study reveals that flipped classroom model enhances the students' achievements. This finding is similar to the previous studies like Strayer, Hart, and Bleiler (2015) and Kirvan, Rakes, and Zamara (2015).

Students' Engagement Data analysis

This description will explain the data from the survey after is analyzed using SPSS. The result will describe whether the students agree that flipped classroom model make them more engage during the lessons. Means, standard deviations, minimum values and maximum values are used to answer this relation. The result is as follow in Table 3.

Table 3. Descriptive Statistics for Data Survey

	<i>Q</i> ₁	<i>Q</i> ₂	<i>Q</i> ₃	<i>Q</i> ₄	<i>Q</i> ₅	<i>Q</i> ₆	<i>Q</i> ₇	<i>Q</i> ₈
Mean	3.934	4.165	4.209	4.143	4.033	3.747	3.846	3.725
Std. Deviation	0.712	0.703	0.624	0.724	0.640	0.825	0.893	0.684
Minimum	3.000	3.000	3.000	3.000	2.000	2.000	2.000	2.000
Maximum	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000

The data above shows that question: (*Q*₁) during class, I ask questions has mean almost 4 ($M=3.93$, $SD=0.71$) which indicates agree. In addition, the minimum value (min=3) explains that there is no negative responses in this item. In other words, all students agree with this statement. The same results are also for item 2 to item 4, that was: (*Q*₂) during class, I express my preferences and opinions, (*Q*₃) I pay attention in the class, (*Q*₄) I try very hard in the class. Item (*Q*₅) I enjoy learning new things in class, has mean ($M=4.03$, $SD=0.64$). It reveals that most of the students also agree with this statement. However, the minimum value (min=2) indicates that there are few students do not agree with this item. This result is similar to item 6 to item 8, that was: (*Q*₆) When I am in class, I feel curious about what we are learning, (*Q*₇) When I am in class, I feel curious about what we are learning, (*Q*₈) I make up my own examples to help me understand the important concepts I study. Students in the flipped classroom model agree that their engagement increase because of this class model.

Another analyzed is used to see whether all items of engagements above have correlations to the posttest from flipped classroom model. Furthermore, this analysis is also used to see how strong the correlations and what kind of correlations they are. The result is on the Table 4.

Table 4 reveals that all items have positive correlation, which mean that the more students engage in the lesson the better their posttest results. According to Akoglu (2018), the Pearson's correlation coefficients of $0.3 \leq r \leq 0.6$ have moderate strong correlation. Based on the table, seven items (item 2 to 8) have coefficients' correlation above of 0.3 ($0.337 \leq r \leq 0.596$, $n=91$, $p\text{-value}=0.001$). These indicate that the correlations between them are moderate strong. Only item 1 has a weak correlation ($r=0.269$, $N=91$, $p\text{-value}=0.010$). It explains that item 1 has little influence to posttest result. Therefore, all of these findings hint that engagement has positive and moderate correlation to the students' achievements.

Table 4. Correlations Analysis for Data Survey

	Q ₁	Q ₂	Q ₃	Q ₄	Q ₅	Q ₆	Q ₇	Q ₈
Flipped	0.269	0.337	0.479	0.471	0.436	0.478	0.596	0.493
Sig	0.010	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Another finding is that the students' engagement also increases during the lesson because of this classroom model. This finding relates to some previous studies which conducted by Jamaludin and Osman (2014) and Clark (2015). Because of these positive results of using flipped classroom model, this model could be implemented to other subjects in junior high schools.

CONCLUSION

This study has given great experiences not only for students but also for the teacher itself. It shows that the flipped classroom model is one of the excellent teaching models which provides the students enough opportunity and time to deeper their understanding and enhance theirs' engagement during the lessons. This study reveals that flipped classroom model enhances the students' achievements. Another finding is that the students' engagement also increases during the lesson because of this classroom model. Because of these positive results of using flipped classroom model, this model could be implemented to other subjects in junior high schools.

To increase the quality of flipped classroom model, teachers gathering is needed to discuss and share how to create interesting videos lesson before implementing this model. In addition, more attention from students' parents is also essential to guide their children when they are watching the videos lesson.

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