Employing PowerPoint in the Flipped-Learning-Based Classroom to Increase Students' Understanding: Does It Help?

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Abstract: Many studies show the effectiveness of using the Flipped Learning model to increase students' understanding. However, there are scant research results that integrate PowerPoint in Flipped Learning to improve students' understanding. The present study aimed to describe the effectiveness of the PowerPoint-Based Flipped Learning model in increasing students' understanding. The recent study is an experimental study with 115 participants divided into a class with a PBFL model, a class with a Flipped Learning model, and a class with a conventional model. The sampling technique used was random cluster sampling, and the data collection was collected through documentation and test method. By using the One-Way ANOVA test, it was found that there was a difference in the mean between the three classes with a significant difference below 0.05. Therefore, a post-hoc test was carried out using the Scheeffe test. The results showed that integrating PowerPoint in the Flipped Learning model significantly increased students' understanding of the material being taught compared to the other classes. All in all, integrating PowerPoint is shown to help strengthen the Flipped Learning-based learning process to improve students' understanding. In addition, this research can still be expanded by broadening the range of research subjects.

Keywords: Flipped Learning, PowerPoint, Aiken's Value, Students' Understanding

1. Introduction

Education is an effort to improve the quality of human life wherewith education, people can be more civilized and adapt to global challenges. In addition, education can help people to increase opportunities for the sustainability of their lives (Idris et al., 2012). Thus, good education quality must be obtained from an early age. Therefore, the school as an educational institution must ensure that the learning process in the school can help students obtain provisions to create opportunities for the sustainability of their lives (Chung et al., 2020). The provision in question is the knowledge obtained from the material taught by the teacher. Therefore, teachers must be equipped to use various strategies to improve students' understanding of the materials taught (Mirioglu, 2020). The strategy to choose from is to utilize technology, which is using PowerPoint applications.

PowerPoint is an application from the Office package developed by Microsoft that is useful for creating slide shows used for presentations (Microsoft, 2020). The supporting feature had this application has helped and made it easier for its users to customize the slides according to their wishes so that the presentation's purpose is achieved. If drawn into the education area, Ishartono & Sufahani (2019) revealed that PowerPoint could be maximized as a visual learning medium. In addition, from the student aspect, using PowerPoint in the learning process can increase student involvement in the learning process and increase student understanding of abstract material (Ishartono et al., 2022; Kahraman et al., 2011; Wanner, 2015). Therefore, optimizing the use of PowerPoint in the learning process is considered very important to do through the Flipped Learning model.

The Flipped Learning model, in principle, has a learning flow that is the opposite of the conventional learning model, wherein the conventional learning model, the material is introduced in the classroom. Conversely, in the Flipped Learning model, students' introduction of topics to be taught is done outside of class hours. This is in line with the statement from El Miedany (2019), which states, "*Flipped learning is a pedagogical teaching approach in which the conventional notion of classroom-based learning is inverted so that students are introduced to the learning material before class, with classroom time then being used to deepen understanding through discussion with peers and problem-solving activities facilitated by teachers*", as well as the statement from Roehling (2018) which states that Flipped Learning is a student-centered pedagogy model in which lecture move to the online environment and class time is spent to engage students in active learning experiences. Therefore, the concept from Revised Bloom Taxonomy (Anderson & Krathwohl, 2001), argues that position Lower Order Thinking Skills (LOTS) and Middle Order Thinking Skills (MOTS) should be placed outside of class hours so that during class hours, only teach the material with an approach of Higher Order Thinking Skills (HOTS), so that learning becomes meaningful. In addition, previous research has shown many benefits from implementing a learning model, Flipped Learning, like to increases students' knowledge, skills, engagement, achievement, and learning motivation (Adams & Dove, 2018; Murillo-Zamorano et al., 2019; Ratih et al., 2021; Seman et al., 2019; Winter, 2018).

Based on the benefits of using PowerPoint and the application of the Flipped Learning model in the learning process that has the same thing, which is to improve student understanding, it is considered possible to integrate the PowerPoint application with the Flipped Learning model to get a better quality of learning from the aspect of student understanding. In principle, the learning model by integrating PowerPoint with the Flipped Learning model or PowerPoint-Based Flipped Learning is a learning model where students will build their knowledge regarding the material being taught through PowerPoint media outside of class hours. This scenario is based on Ishartono & Sufahani (2019) research findings were in their research, students as research subjects are asked to create PowerPoint slides from materials provided by lecturers. Then Ishartono & Sufahani examined the cognitive processes of the students and obtained that in making PowerPoint slides, the subject must study the learning materials provided by the lecturer and then arrange the material order to be presented in the slide, and ultimately evaluate both formative and summative to check if the slide that has been developed is correct and valid. This can be concluded that PowerPoint can help students construct their knowledge. Next, when entering real lesson hours, the teacher can use the time to apply the HOTS approach to the learning process. Thus, it can be hypothesized that integrating the PowerPoint application into the application of the Flipped Learning model can improve students' understanding of a taught topic.

Some previous studies have shown efforts to improve student understanding through Flipped Learning models, such as research from Sajid et al. (2016) who applied the Flipped Learning model to medicine learning involving 127 students as participants. The results of the study stated that students' learning performance improving during the learning process. In addition, a research conducted by Lai & Hwang (2016) also showed an increase in students' understanding of mathematics learning carried out using the Flipped Learning model. While related to the use of PowerPoint software and its connection to the Flipped Learning model, some previous studies show that the PowerPoint application is only used as a medium for teachers to teach during the Flipped Learning-based learning process (Chyr et al., 2017; González-Gómez et al., 2016; Tomas et al., 2019). This is most likely because many teachers still view PowerPoint as a medium for teachers' teaching, not for students to construct their knowledge.

The present study was an effort to fill the lacunae mentioned above using the PowerPoint-Based Flipped Learning model to increase students' understanding of a learning topic. It also examined how practical the application of the PowerPoint-Based Flipped Learning Model was in improving students' understanding of the material being taught to them. Therefore, the present study used observation and tests to answer the research question about how effective the PowerPoint-Based Flipped Learning model is in increasing students' understanding of the material being taught? Hence, the objectives of the present study is to test the effectiveness of implementing the PowerPoint-Based Flipped Learning (PBFL) model in increasing students' understanding of the material being taught.

2. Method

2.1 Research Subject

This experimental research was conducted for two months, from May - June 2020 (seven meetings), involving 115 students with an average age of 18 and 22 years at a university in Indonesia in the 2019/2020 academic year participants. The sampling technique used random cluster sampling. The participants were divided into three classes (from six parallel classes), randomly selected. The course chosen was the Plane Geometry Analytic course, which has six parallel classes so that the random sampling method can be more flexible to be applied. The classes were categorized (1) the experimental-1 class that received the PowerPoint-Based Flipped Learning Model, (2) the experimental-2 class that received the Flipped Learning Model treatment, and (3) the control class that received treatment in the form of conventional learning. The research design is presented in table 1.

Table 1. Research Design

Class	Treatment
Experiment 1	X_1
Experiment 2	X_2
Control	O

Description:
X_1: Classes that get PowerPoint-Based Flipped Learning treatment
X_2: Classes that get Flipped Learning treatment
O: Classes that get conventional learning treatment

2.2 Data Collecting Techniques and Instruments

Because this study aimed to test the effectiveness of PowerPoint-Based Flipped Learning to improve students' understanding of the topics being taught, there are two data collection techniques: documentation and test. A documentation technique was used to obtain initial capability data to test whether the sample is usually distributed and homogeneous. The documentation data collect from the midterm test result from the class taken as a sample in the Plane Geometry Analysis course. While on the test instrument, the type of test used is a written test on the Plane Geometry Analytic course. The test questions are in the form of four essay questions with competency weights equivalent to the fourth competency in the cognitive field in Revised Bloom's Taxonomy, namely the analysis level (Anderson & Krathwohl, 2001). Before the test questions were given to students, the questions were tested for their validity using Aiken's Value to calculate its Content Validity Index/CVI (Retnawati, 2016). This test involved four evaluation experts from two private universities in Indonesia who hold a doctoral degree. It was found that the questions were valid to be used based on the validation test. The formula of Aiken's Value can be described as follows (Azwar, 2012):

$$\boldsymbol{CVI} = \frac{\sum \boldsymbol{s}}{\boldsymbol{n}(\boldsymbol{c} - \mathbf{1})}$$

Where:

CVI	:	Content Validity Index
s	:	The score set by each validator minus the lowest fuse in the category used, or in another words $s = r - l_0$, with r is the category selected by the validator, dan l_0 is the lowest score in the grading category
n	:	The number of validators
c	:	Number of categories which validators can choose from

2.3 Data Analysis Techniques

In the pre-experimental process, the researcher documented the participants' midterm test scores for the next Kolmogorov-Smirnov normality test to show whether the three classes were normally distributed. The Bartlett homogeneity test was used to determine whether the three classes were homogeneous, and the balance test used the One-Way ANOVA Test to determine whether the three classes have a balanced ability (Setyaningsih et al., 2019; Sugiyono, 2013). Next, in the post-experiment process, the data on the participants' post-test scores in the final exam were collected for normality, homogeneity, and hypothesis testing. Furthermore, the hypothesis test results are carried out with further post-ANOVA testing using the Scheffe test if there are differences in the treatment results. It was to determine which class experienced mean differences (Mertens, 2010). All such tests are conducted using SPSS 16.0.

2.4 Procedures

The present study was conducted in a natural classroom setting. At first, researchers determined three random sample classes from six existing classes. The first class (Experiment-1 Class) class receives learning with the PowerPoint-Based Flipped Learning model (n = 39), the second class (Experiment-2 Class) receives learning with the Flipped Learning model (n = 39), and the third class (Control Class) receives conventional learning (n = 37).

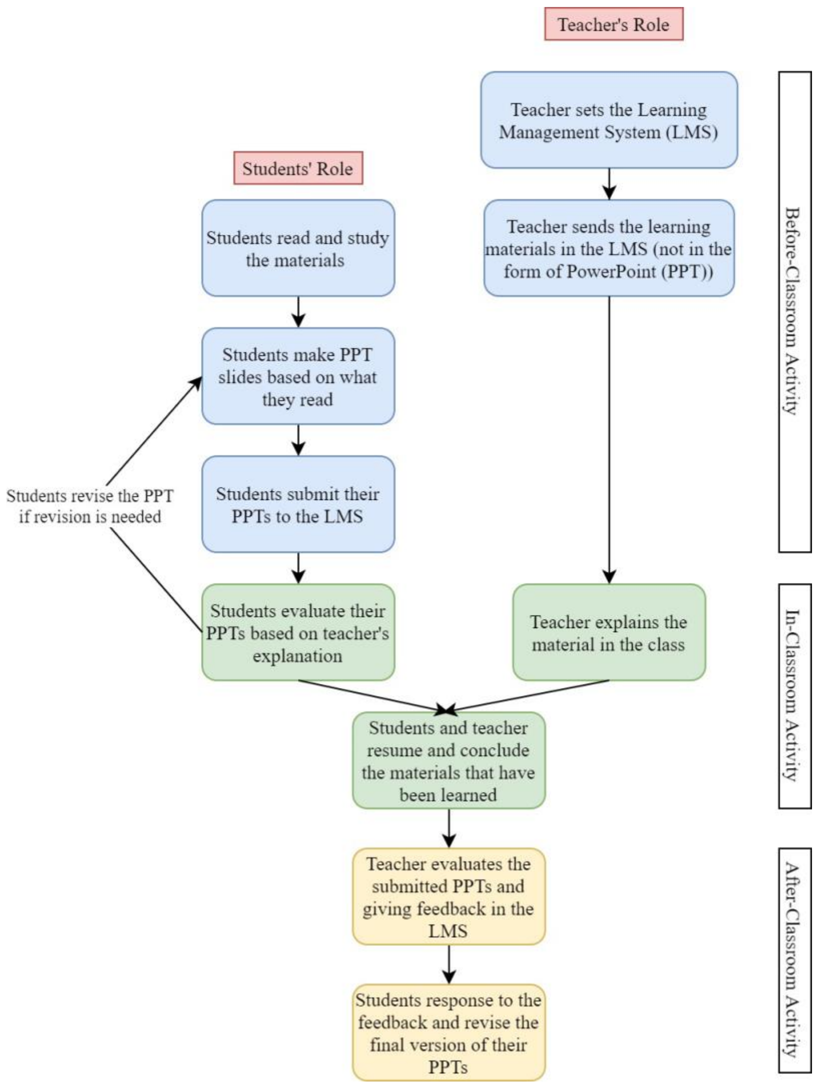


Fig 1. The activity flow of the Experiment-1 classes

In the Experiment-1 Class, before lectures begin, the lecturer prepares learning materials in the form of modules given to participants to study. Learning materials are provided using the Learning Management System (LMS), namely Schoology. After the participants studied the given study material, they were given the task of retelling the topics they had learned in PowerPoint slides. After they finish working on the assignment, students are asked to upload the assignment to the LMS, and then the lecturer examines the results of the participants' work. Furthermore, in the lecture class, the lecturer confirms their knowledge by briefly explaining the learning materials that have been sent. Then the lecturer reminded the participants that if there was a misconception, they had written in PowerPoint that they had worked on to be corrected after finishing lectures. Also, lecturers deepen the teaching process in the class by using the HOTS approach to develop students' knowledge, which they have previously acquired. After the lecture class session, the lecturer asks students to recount the PowerPoint they have revised and re-upload it to the LMS. The flow diagram of the Experiment-1 class activity can be seen in Fig 1.

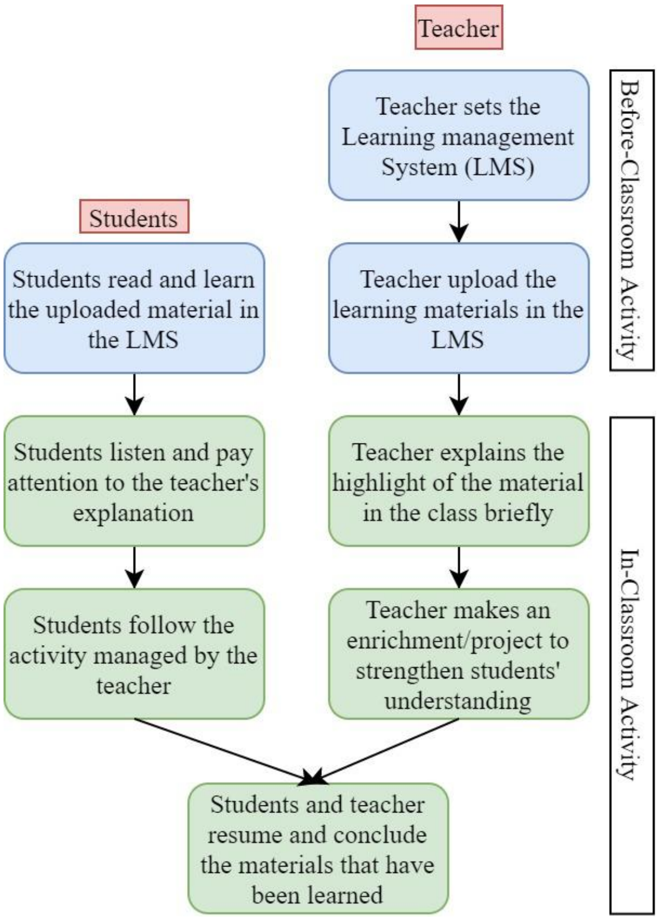


Fig 2. The activity of the Experiment-2 Class

In the Experiment-2 Class, the learning design is a modification of the Flipped Learning flowchart designed by Çakiroğlu & Öztürk (2017). The difference is in the design developed by Çakiroğlu & Öztürk; students were given the option to choose activities in the form of group or individual activities. While flipped learning model design in the present study only uses individual activities of students. In detail, the lecturer prepares learning materials in the form of modules for students and distributes them to the participants through the LMS used. Next, students learn the learning material independently. Furthermore, in the lecture class, the lecturer confirms student understanding by discussing the learning materials that have been given to students and followed by lecture activities (the flowchart of this activity can be seen in Fig 2). Meanwhile, in the Control Class, the lecturer explains the topics being taught in total, starting from introducing the topics being taught to enrichment through exercises in solving questions.

Based on the previous description of each class, it can be seen that the difference between Experiment-1 Class and Experiment-2 Class is in the use of PowerPoint as an additional medium to strengthen participants' understanding of the topics being taught. Whereas in the Control Class, the lecture process occurs conventionally, where the lecturer uses the lecturing method throughout the lecture.

3. Result and Discussion

3.1 Result

3.1.1 Pre-Experimental Process

In this pre-experimental process, the researcher conducted a homogeneity test, normality test, and balance test against the participants' documented midterm test scores. At first, the researcher conducted a normality test of the scores by using the Kolmogorov-Smirnov test, and the results can be seen in Table 2.

Table 2. Normality Test in the Pre-Experimental Process

Class	Kolmogorov-Smirnov		
	Statistics	df	Sig.
Experiment-1 Class	0.107	39	0.200
Experiment-2 Class	0.119	39	0.178
Control Class	0.127	37	0.139

From Table 2., it can be seen that the significance of the three classes is more significant than 0.05, which means that the three classes are normally distributed. Next, it was followed by conducting a homogeneity test of the documented data. The results can be seen in Table 3.

Table 3. Homogeneity Test in the Pre-Experimental Process

Levene Statistics	df1	df2	Sig.
2.276	2	112	0.107

From Table 3., it can be seen that the three classes have a significance level of 0.107, which is greater than 0.05, which means that the three classes have the same variance. Furthermore, after the samples were obtained from normal and homogeneous populations, the balance test was continued using the One-Way ANOVA Test. The results of these tests can be seen in Table 4.

Table 4. One Way ANOVA Test in the Pre-Experimental Process

	Sum of Square	df	Mean Square	F	Sig.
Between Groups	79.890	2	39.945	0.101	0.904
Within Groups	44315.971	112	395.678		
Total	44395.861	114			

Table 4. shows that the significance value is 0.904, which is greater than 0.05, which means that the three classes have the same average score so that it can be stated that the three classes have equal abilities. Because the assumptions of normality, homogeneity, and balance have been fulfilled, the research process can continue to the experimentation stage to test whether there are differences in the mean values obtained from the three classes after receiving treatment during the research process. If there are differences, it will be tested whether the PowerPoint-Based Flipped Learning model is better than the Flipped Learning-based class and the control class.

3.1.2 Post-Experimental Process

The study was conducted for two months between May and June 2020. During these two months, the three classes received treatment in the lecture process described in the Procedure section. After completing seven lectures (two months), students are given a post-test in the form of a final exam. After that, the researcher documented the student's test scores for subsequent statistical analysis. At first, the student score data were tested for normality to determine how normal the distribution was using the Kolmogorov-Smirnov test. The results of the normality test can be seen in Table 5.

Table 5. Normality Test in the Post-Experimental Process

Class	Kolmogorov-Smirnov		
	Statistics	df	Sig.
Experiment-1 Class	0.081	39	0.200
Experiment-2 Class	0.090	39	0.200
Control Class	0.132	37	0.100

Table 5. illustrates that the three classes come from populations that are normally distributed. This condition can be seen from the significance value of the three classes, which is above 0.05. Next, to determine the level of variance of the participants' post-test scores, homogeneity will be tested, and the results can be seen in Table 6.

Table 6. Homogeneity Test in the Post-Experimental Process

Levene Statistics	df1	df2	Sig.
1.096	2	112	0.347

Table 6. provides information that the variance of the three classes has the same variance with a significance level of 0.347, which is greater than 0.05. Next, the post-test scores were carried out by a hypothesis test where H0 stated no significant difference between the three classes, and H1 stated a significant difference between the three classes. Hypothesis testing uses one-way ANOVA. The test results can be seen in Table 7.

Table 7. One Way ANOVA Test in the Post-Experimental Process

	Sum of Square	df	Mean Square	F	Sig.
Between Groups	4933.058	2	2466.529	31.447	0.000
Within Groups	8784.733	112	78.435		
Total	13717.791	114			

From Table 7. It can be seen that the significance value obtained is 0.000, with a confidence level of 95%, the significance value obtained is smaller than 0.05, which means that H_0 is rejected and H1 is accepted. Hence, there are significant differences between the three classes. Furthermore, the post-hoc test was carried out using the Scheffe test because it was the most rigorous (Budiyono, 2004). The results of the post-ANOVA follow-up test using the Scheffe test can be seen in Table 8.

Table 8. Post-Hoc Test by Using Scheffe Test

(I) Classes	(J) Classes	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Experiment-1	Experiment-2	8.949*	2.006	0.000	3.97	13.92
	Control	16.065*	2.032	0.000	11.02	21.11
Experiment-2	Experiment-1	-8.949*	2.006	0.000	-13.92	-3.97
	Control	7.116*	2.032	0.003	2.07	12.16
Control	Experiment-1	-16.065*	2.032	0.000	-21.11	-11.02

(I) Classes	(J) Classes	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
	Experiment-2	-7.116*	2.032	0.003	-12.16	-2.07

*. *The mean difference is significant at the 0.05 level*

From Table 8, it can be seen that each class has a significant difference from one another, so it appears that a significant difference in mean occurs between classes. If we look further in the Mean Difference column, it can be seen that many Experiment-1 classes have positive mean differences both for the Experiment-2 class and with the control class. Next, it can also be seen that the Experiment-2 class also has a positive mean difference to the control class. So it can be interpreted that the average Experiment-1 class is better than the Experiment-2 class and the control class, and also, the Experiment-2 class is better than the control class.

3.2 Discussion

This paper examines whether applying the PowerPoint application in learning based on the Flipped Learning model has an adequate level of effectiveness in increasing students' understanding of the material being taught to them. Based on the results obtained, it shows that the integration of PowerPoint in learning based on the Flipped Learning (PowerPoint-Based Flipped Learning / PBFL) model has a good significance in increasing students 'understanding, which in the context of this study is to increase the participants' understanding of the topics being taught there are Plane Geometry Analytic course.

In detail, in the third column of Table 8., it appears that only the PBFL class has a positive mean difference compared to the other two classes, namely 8,494 against the Experiment-2 class and 16,065 against the control class. Meanwhile, the Experiment-2 class has a negative mean difference to the Experiment-1 class, and the control class also has a negative mean difference between the Experiment-1 class and the Experiment-2 class. This means that the application of PBFL in the learning process can help increase students' understanding of the material taught more significantly compared to Experiment-2 class that uses Flipped Learning model and control classes that use conventional learning models. In other words, it can also be concluded that the involvement of PowerPoint in the Flipped-Learning class can help students better understand the materials taught compared to the conventional-Flipped-Learning class.

One of the promoted aspects of PowerPoint-based Flipped Learning is students' independence in constructing their knowledge and understanding of the materials taught through PowerPoint. In the context of this study, the course taken was Plane Geometry Analytic, where in this course explained the concepts of geometry combined with the concept of algebra and calculus (Koyuncu et al., 2015). One of the materials taught is about proving one of the theories in the triangle that the line connecting the midpoints of the two sides of a triangle will be parallel to the third side and the length of the third half side. In other words, if there is any triangle ABC with the midpoint of the two sides are D and E, then the theory says that $\overline{DE}//\overline{AB}$ and $\overline{DE} = \frac{1}{2}\overline{AB}$ (see Fig. 3).

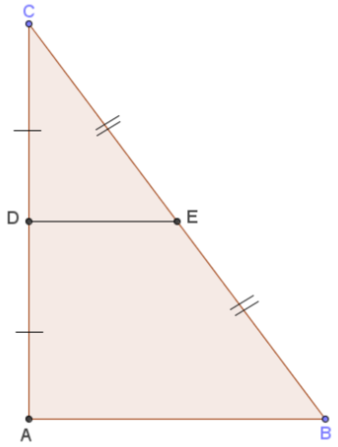
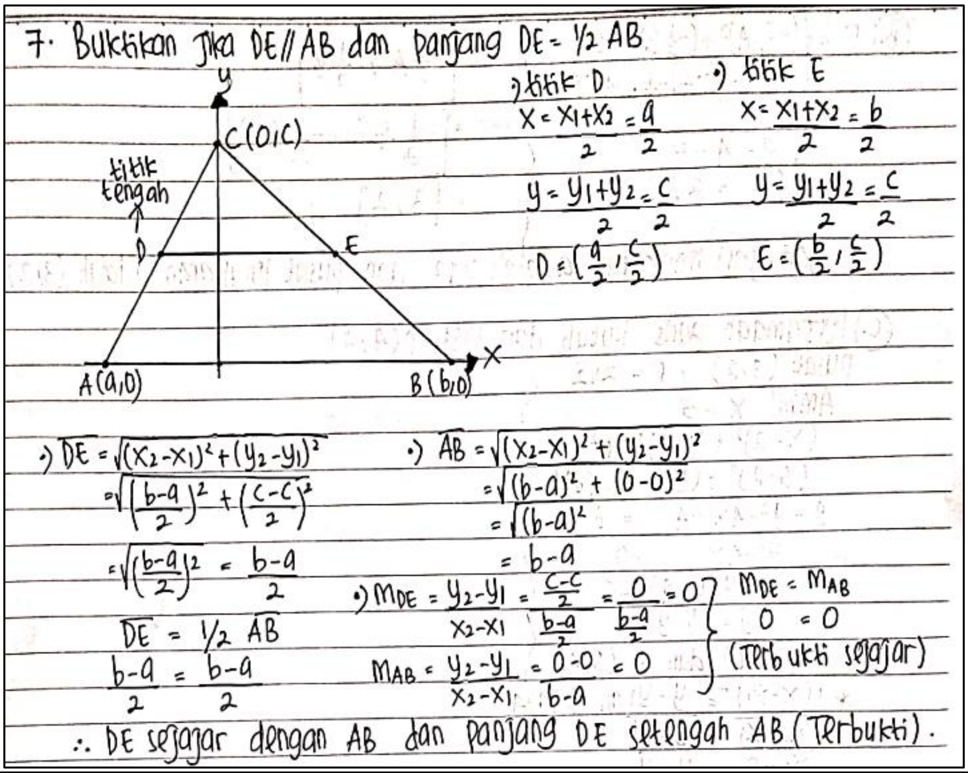


Fig 3. Illustration of the triangle ABC

This theorem requires students to use their prior knowledge related to the concept of congruency used as the basis for proving the theorem. In the post-test of this study, the theorem became one of the questions tested to students in all sample classes. In this section, the authors will use the student's work to show that students in experimental classes who use PowerPoint to construct their understanding will be better at understanding concepts than students who do not use PowerPoint. During assessing and evaluating students' work on questions given to them, the authors found that most students in the class of Experiment 1 could answer the question correctly and logically. One sample is the work done by the student with initial KAM, as depicted in Fig. 4.

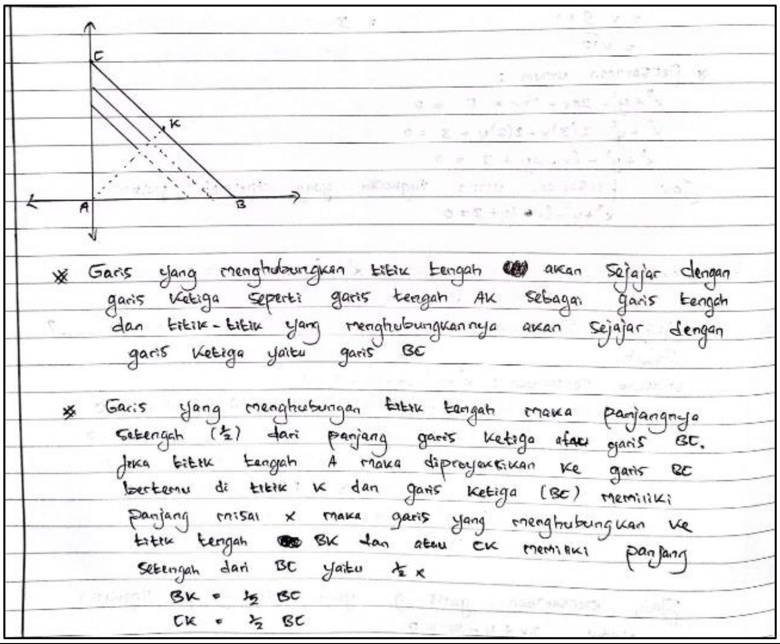


Translation:
7. Prof that $\overline{DE}//\overline{AB}$ and the length of $\overline{DE} = \frac{1}{2}\overline{AB}$.
∴ DE is parallel to AB and the length of DE is half of AB

Fig 4. KAM's work in answering the proof of triangle formula

Fig 4. indicates that KAM can explain in detail the process of proofing the theorem asked on the question. KAM begins by first illustrating the triangle in question and its dots. By illustrating it, KAM determined the plan of proof of the theorem seen from the way KAM presented the results of his work. At the beginning of the work, KAM starts by first determining the coordinates D and E, then determines the length of DE and AB, so it is obtained that DE is half of AB. Then based on the results of the calculation, KAM proves the alignment of DE and AB by showing the gradient of the DE and AB lines obtained by 0 each. So, it is proven that the two lines are parallel. From the way KAM worked on the proof of the theorem, it appears that she understands the concept of the theorem so that he can prove it correctly and sequence.

The different results were shown by most students in Experiment 2 and the Control Class. Many students from both classes can provide a clear and detailed explanation related to proving the triangular theorem. One example of the students' work is a student with the initial HND who comes from a control class where the geometry learning process he gets is not based on PowerPoint-based Flipped Learning. As seen from Fig 5, it was found that HND could not explain the logic of proving the triangle theorem correctly and adequately. Every argument written by HND is still assumption without using an excellent algebraic thought process. So, all premises used are invalid and tend to be weak. Like KAM, HND begins the evidentiary process by first creating an illustration of the triangle and the position of each point. However, the illustrations performed by HND are not as specific as KAM does, where HND does not include any coordinates in the illustration. In theory, the ability to illustrate mathematical objects is one part of the skills of mathematical representation (Minarni et al., 2016). So, the lack of ability to illustrate mathematical objects will impact creating a problem-solving plan (Cartwright, 2020). This can be seen from the narrative argument made by HND where he can only narrate all his arguments without being able to give a precise and based calculation.



Translation:
The line joining the midpoints will be parallel to the third line like the centerline AK. As the center line and the points connecting it will be parallel to the third line that is BC

The line connecting the midpoints is half the length of the third line or line BC. If the midpoint of A is projected onto the line BC to meet at point K and the third line (BC) has a length of e.g., x, then the line connecting to the midpoint of BK and the midpoint of CK has a length of BC, namely ½.

Fig 5. HND's work in answering the proof of triangle formula

In the present study, PowerPoint acts as a medium for students to communicate what they have read and learned again so that during the process of making presentation slides, they consciously construct and organize their knowledge structures to help them compile and organize the concepts they have. It is undoubtedly in line with the research results from Gambari, Yusuf, & Balogun (2018), which states that the involvement of PowerPoint in learning can help learners' cognitive skills to structure their knowledge. The existence of cognitive skills possessed can certainly improve student academic achievement. This result supports the study from Bokosmaty, Bridgeman, & Muir (2019) that Flipped learning using PowerPoints can increase student involvement, memory, and academic achievement. Otherwise, in the context of its involvement as part of the Flipped Learning process, the role of PowerPoint can strengthen students' knowledge before class starts. It can be seen in the research procedure that before students enter the learning process, students use PowerPoint to formulate and organize concepts that they have understood using their language. So, when they are in the learning process, students are ready with the materials that the teacher will teach. In addition, teachers can increase their learning level at the level of analysis, evaluation, or even creation. In the end, the learning process can be more meaningful for students. This condition is in line with the research results by Huang, Chiu, Liu, & Chen (2011), which state that one of the characteristics of meaningful learning is constructive, which means that students can independently be actively involved in constructing their knowledge.

Indeed, this research can still be developed again by taking in a broader subject and a different subject education level. It is hoped that the results of this research can be an alternative solution for practitioners in the field of education in carrying out online learning based on Flipped Learning effectively and efficiently so that the learning process can run more comprehensively.

4. Conclusion

The present study aimed to describe the effectiveness of implementing the PowerPoint-Based Flipped Learning (PBFL) model in increasing students' understanding of the material being taught. Based on the discussion section, the present study succeeded in answering the hypothesis that the application of PowerPoint-Based Flipped Learning was significantly effective in improving students' understanding on the material being taught. It also means that employing PowerPoint in the Flipped-Learning-based instruction effectively helped the improvement of students' understanding. To verify these results, a series of experimental procedures involving three classes was carried out. This study's results are also expected to reference researchers, teachers, and students who will use the PowerPoint application in Flipped Learning model to improve students' understanding. This research can still be continued by expanding the quality and quantity of subjects used, such as from the number and level of education such as elementary and secondary school. It is hoped that the results of this study can help educational practitioners to be able to realize effective and efficient online learning.

5. Suggestion for Future Research

This research can still be continued by expanding the quality and quantity of subjects used, such as from the number and level of education such as elementary and secondary school. Besides, a qualitative study can also be conducted for further study to explore the students' process of thinking during the learning process based on the PBFL.

6. Co-Author Contribution

The authors affirmed that there is no conflict of interest in this article. Author 1 wrote all the sections and analyse the data statistically. Author 2 and author 3 interpreted the data and review the content of the manuscript. And author 4 did the data collection and entry.

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