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## MEASURING UNDERSTANDING OF ANOVA MATERIAL THROUGH THE FLIPPED CLASSROOM LEARNING METHOD

### Abstract

During the Covid-19 pandemic, student learning is done from home with online learning. Many teachers use methods to adjust learning from face-to-face to face-to-face online. One of the learning methods used is the flipped classroom. In several studies, this method has been able to improve students' mathematics skills. Based on this background, researchers are interested in examining the effectiveness of using the flipped classroom method in ANOVA learning at the university level. The subjects of this study were students of the land transportation study program at STTD Bekasi and statistics at Matana University. The number of research subjects was 14 students. The data analysis method used was the non-parametric sign test to paired population method. From the analysis carried out, the results showed that the flipped classroom method applied resulted in a significant increase in students' ANOVA material learning outcomes.

**Keywords:** Flipped classroom, ANOVA, Effectiveness, Statistics, College Student

### Abstrak

Di masa pandemi Covid-19, pembelajaran siswa dilakukan dari rumah dengan pembelajaran daring. Banyak guru yang menggunakan metode untuk menyesuaikan pembelajaran dari tatap muka menjadi tatap muka online. Salah satu metode pembelajaran yang digunakan adalah flipped class. Pada beberapa penelitian, metode ini telah mampu meningkatkan kemampuan matematika siswa. Berdasarkan latar belakang tersebut, peneliti tertarik untuk mengkaji keefektifan penggunaan metode flipped class dalam pembelajaran ANOVA di tingkat universitas. Subyek penelitian ini adalah mahasiswa program studi transportasi darat STTD Bekasi dan statistika Universitas Matana. Jumlah subjek penelitian adalah 14 siswa. Metode analisis data yang digunakan adalah uji tanda non parametrik hingga metode populasi berpasangan. Dari analisis yang dilakukan diperoleh hasil bahwa metode flipped class yang diterapkan menghasilkan peningkatan hasil belajar materi ANOVA siswa secara signifikan.

**Kata Kunci:** Flipped Classroom, ANOVA, Efektivitas, Statistika, Mahasiswa

### INTRODUCTION

The productive generation in Indonesia nowadays, in 2024, will be dominated by the millennial and Z generations. Quoted from the Ministry of Finance website Gen Z is the generation born in 1997–2012. This generation is now 8–23 years old. While Millennials are the generation born in 1981-1996 (currently 24-39 years old). This generation is predicted to be the mainstay of Indonesia's golden age in 2045. The demographic bonus that Indonesia has can be a blessing or a disaster. It is a blessing when this generation is literate in education; it is a disaster if this generation is less technologically savvy so that it loses out to human resources from other countries.

Learning is a process of gaining meaningful experiences by students to gain knowledge. Meaningless learning will be a bad experience for students. The consequences of not enjoying learning can have a bad impact, one of which is that students will think that school is useless and a waste of time. This is reinforced by the debate about whether school is necessary. On the University of the People website

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Based on the lecturer's observation while teaching land transportation study program students several years before the pandemic, the students' general abilities were quite good regarding mathematical analysis; however, when the ANOVA material was taught, the average class score was always the lowest among other parametric statistical tests, which was less than 75. However, when the Covid pandemic took place, this fact was refuted, namely for the ANOVA course, the average score became good, as well as other statistical test materials, which were more than 85.

This change is hypothesized due to the fact that, during the learning process at home, students have the opportunity to utilize a variety of sources for independent study. The method of independent learning that has been implemented is the flipped classroom. The flipped classroom learning method is a learning method where students, before studying in class, first study the material at home according to the assignments given by the teacher. Research on learning using flipped classrooms has been studied by applying flipped classrooms to junior high school students when the COVID-19 pandemic hit the world and resulted in the conclusion that the learning outcomes of students using flipped classrooms were better than the mathematics learning outcomes of students with conventional learning. Furthermore, prior to the onset of the pandemic, investigations into flipped classrooms were carried out, notably by Damayanti and Sutarna (2016) with vocational school students as subjects, to test the creative nature, responsibility, and independence of learning with. This study produces The results of this study show that the effectiveness of the flipped classroom-based mathematics learning model for class XI SMKN 1 shows that the flipped classroom-based learning model applied to class XI SMKN 1 Gedangsari is effective in improving creative attitudes, responsibility, and learning skills. Fianingrum et al. used the flipped classroom to see the effectiveness of this method on mathematics learning, with the results that by applying the flipped classroom learning model, it can improve problem-solving skills, conceptual understanding skills, mathematical literacy skills, learning independence, attitudes and skills in learning mathematics, as well as mathematical reasoning skills.

Based on this background, the researcher focuses on using the flipped classroom method for ANOVA learning for students of the land transportation study program, STTD Bekasi, and collaboration with the statistics study program, Matana University. From the use of the flipped classroom method, it will be examined whether this flipped classroom method is effective in improving the ability to understand statistics, especially in ANOVA material.

## **METHOD**

### **Metode Flipped Classroom**

Flip Classroom is a student-based learning method for independent learning. Based on research conducted in America and also several campuses in Indonesia that have practiced flipped classrooms, the results are very encouraging and the quality is better. Quoted in The steps of a flipped classroom are:

1. Lecturers distribute lecture materials and assignments.
2. Lecturers accompany students to conduct discussions.
3. Lecturers give tests to determine the level of student understanding.
4. Lecturers provide reinforcement for the material given face-to-face.

### **Parametric $t$ –paired Test**

The data analysis of this study used the statistics of the sign test for a paired experiment. Based on , the sign test for a paired experiment is used to compare two populations when the sample is a paired sample. In this study, the sign test used is the sign test for a paired experiment is paired  $t$ -Statistics. The sample pairs referred to in this study are samples of students who carry out flipped classroom learning before the material reinforcement by the lecturer and after being given the material reinforcement process by the lecturer, namely after the lecturer explains the learning material face-to-face directly in class.

Data analysis using the  $t$ -paired sample test is as follows:

#### **Assumption:**

1. Simple random paired sample,
2. Normal difference or large sample.

**Step 1.** Write the null hypothesis and alternative.

$$\begin{array}{l}
 H_0: \mu_1 = \mu_2 \\
 H_a: \mu_1 \neq \mu_2
 \end{array}
 \quad \text{or} \quad
 \begin{array}{l}
 H_0: \mu_1 = \mu_2 \\
 H_a: \mu_1 < \mu_2
 \end{array}
 \quad \text{or} \quad
 \begin{array}{l}
 H_0: \mu_1 = \mu_2 \\
 H_a: \mu_1 > \mu_2
 \end{array}
 \quad \dots\dots\dots (1)$$

**Step 2.** Decide on the significance level ( $\alpha$ )

**Step 3.** Compute the value on the test statistics

$$t = \frac{\bar{d}}{\frac{s_d}{\sqrt{n}}} \dots\dots\dots(2)$$

**Step 4.** Critical value

The critical value(s) are

$$\pm t_{\frac{\alpha}{2}} \quad \text{or} \quad -t_{\alpha} \quad \text{or} \quad t_{\alpha} \quad \dots\dots\dots (3)$$

i

th  $df = n - 1$ . Use table  $t$  to find the critical value

If the value of the test statistic falls in the rejection region, reject  $H_0$ ; otherwise, do not reject  $H_0$ .

**Step 5.** Interpret the result

Interpret the result of the hypothesis test.

**RESEARCH RESULTS AND DISCUSSION**

**Results**

The subjects of this study were 24 joint students, namely 22 students of the land transportation study program, STTD Bekasi, and 2 statistics students of Matana University. The study was conducted for two weeks, namely May 6–13, 2024. The research location is at STTD Bekasi and Matana University. The flipped classroom learning in this study is in accordance with.

1. Lecturers distribute lecture materials and assignments.

One week before face-to-face learning, on May 6, 2024, the lecturer provided information about the ANOVA material that must be studied. The source of student learning is the main ebook that must be used for study. In addition, students can use other learning tools such as YouTube videos, the internet, and discussions with fellow friends.

2. Lecturers accompany students to conduct discussions.

On May 13, 2024, face-to-face learning began. Lecturers accompanied students to have discussions in class about the ANOVA material they had studied during the previous week. An illustration of learning conditions when students discuss and utilize information sources from the internet can be seen in Figure 1.



Figure 1. Students discussing in class

3. Lecturers give tests to determine the level of student understanding.

In this session, the lecturer gave the first test to determine the level of students' understanding of the ANOVA material. The questions given were descriptive questions. The

descriptive questions given were questions with the same character as the pretest. The questions used were deliberately different because they were to measure understanding of the material.

- Lecturers provide reinforcement for the material given face-to-face.

In this session, the lecturer explains the material using lecture and practice methods with the aim of aligning the perception of students' independent learning outcomes. Then at the end, they give similar questions that students must work on after the lecturer provides reinforcement of the material to see whether the results are significantly different from the independent learning results they have done previously.

The results of the 24 students' exams are summarized in table 1 and then analyzed using the following steps:

**Assumption:** Because the sample large, so assumption is satisfied.

**Step 1.** The hypothesis

The hypothesis used in this study is the left-sided test, so the hypothesis used is  $H_0: \mu_1 = \mu_2$  (The average statistical value of the ANOVA material did not differ before and after being given the flipped classroom treatment.)

$H_0: \mu_1 < \mu_2$  (The average statistical value of the ANOVA material is different after being given the flipped classroom treatment, that is significantly higher.)

**Step 2.** Decide on the significance of  $\alpha$ .

The  $\alpha$  value used in this study is 5%.

**Step 3.** Compute the value on the test statistics

By using formula (2), the calculation result is  $t = -5.091$ .

**Step 4.** The critical value.

From  $t$  table we got  $-t_{tabel} = -t_{5\%;23} = -1,714$

Because the  $t_{calculation} = -5,091 < -t_{table} = -1,714$ , so reject  $H_0$  or accepted  $H_a$ .

**Step 5.** Based on statistical data analysis, it was concluded that the average value of the ANOVA material was significantly different after being given the flipped classroom treatment, namely the value was significantly higher.

Table 1. pre-test dan post-test result

id student	Pretest	Postest	id student	Pretest	Postest
1	60	60	13	60	60
2	90	100	14	60	70
3	60	100	15	70	80
4	70	80	16	70	70
5	90	100	17	60	70
6	60	70	18	70	90
7	70	80	19	60	70
8	90	100	20	90	100
9	90	100	21	60	70
10	60	60	22	60	70
11	60	100	23	50	100
12	60	70	24	65	100

## Discussion

Table 2. Descriptive Statistics Pre and Post test

Pre		Post	
Mean	68,125	Mean	82,08333
Standard Error	2,532622302	Standard Error	3,183925
Median	60	Median	80
Mode	60	Mode	100
Quartile 1	60	Quartile 1	70

Quartile 3	70	Quartile 3	100
IQR	10	IQR	30
Standard Deviation	12,4072647	Standard Deviation	15,59798
Sample Variance	153,9402174	Sample Variance	243,2971
Kurtosis	-0,324959641	Kurtosis	-1,70332
Skewness	0,9920667	Skewness	0,072604
Range	40	Range	40
Minimum	50	Minimum	60
Maximum	90	Maximum	100
Sum	1635	Sum	1970
Count	24	Count	24

From this study, it can be seen that the flipped classroom method can significantly increase the statistics scores of students in the land transportation study program, STTD Bekasi, and the statistics study program at Matana University. The role of lecturers in determining student success can also be taken into account. In terms of the results of the student test before being given reinforcement from the lecturer, the average score was 68.125, while after being given reinforcement it became 82.083. From here it can be seen that the role of lecturers in teaching is clearly visible. To further strengthen this assumption, further researchers can add qualitative data analysis methods. Descriptively, the results of the data analysis can be seen in Table 2.

From table 2, it can be seen that the pretest score that students obtained the most was 60, while during the post-test the score that students obtained the most was 100. From the descriptive scores obtained, a whisker diagram can be made for the pretest and post-test, respectively, as in Figure 1.

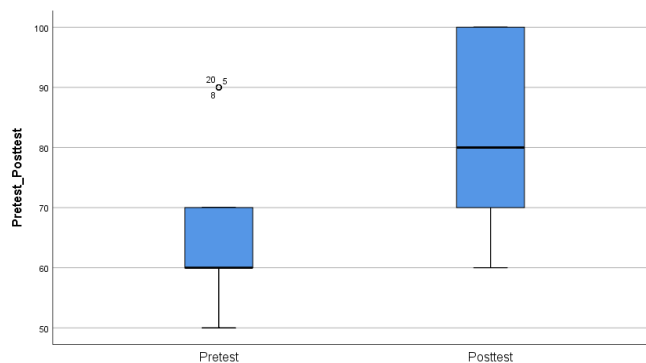


Figure 1. Whisker diagram pre-test (left) dan post-test (right)

The next analysis is how to foster a climate of independent learning for students without being told or asked to do homework for teachers or lecturers. With the findings that the flipped classroom method can actually improve learning significantly, meaning that when students learn independently first the material to be learned from various sources, then in class they are given reinforcement of the material by the teacher, learning outcomes increase significantly. Even out of 24 students who participated in this study, none of them obtained a posttest score lower than their pretest.

**CONCLUSION**

The results of this study indicate that the flipped classroom method applied resulted in a significant increase in learning outcomes of ANOVA material for students of the land

transportation study program, STTD Bekasi, and the statistics study program, Matana University.

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