THE EFFECT OF *FLIPPED CLASSROOM* LEARNING ON REASONING ABILITY IN TERMS OF STUDENTS' MATHEMATICAL ACHIEVEMENT

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ABSTRACT

This research is motivated by the results of the PISA study which shows that the mathematical reasoning abilities of Indonesian students are still low, this is evidenced that Indonesian students in the PISA competition only reach level 4. One solution that is considered capable of solving this problem is by using the flipped classroom learning model for class VIII students of MTS Al-Sa'adah. This study aims to determine the effect of flipped classroom learning on reasoning abilities in terms of students' mathematical achievement. This research is included in the quantitative research with a post-test control group design. The population in this study were all VIII MTS Al-Sa'adah as many as 84 students and obtained a sample of class VIII B as many as 24 students as an experimental class and VIII A as many as 25 students as a control class with the sampling technique used in this study is a type of cluster random sampling. The results of the study prove that there is an influence of the flipped classroom learning model on reasoning abilities in terms of student achievement. This is evidenced by the results of statistical calculations with the t test obtained sig. 0.038 < sig. 0.05. Likewise with the results of the one-way ANOVA test which concluded that there were differences in the average mathematical abilities of students who had high, medium and low achievements after using the flipped classroom learning model. This is evidenced by the statistical test results of sig. 0.00 < sig. 0.05.

Keywords: Flipped Classroom Learning Model, Mathematical Reasoning Ability, Achievement.

INTRODUCTION

The National Council of Teachers of Mathematics (NCTM) sets 6 basic principles in learning mathematics, namely: learning to understand (mathematical *understanding*), learning to *reason (mathematical reasoning), learning to* communicate (mathematical *communication), learning to* connect ideas (mathematical *connection), learning to* present (mathematical *representation), learning to* solve problems (mathematical *problem solving)*. The six combined principles need to be owned by students in order to use mathematics in everyday life. The ability that covers the six objectives is mathematical reasoning ability (Damayanti et al., 2016). Mathematical reasoning is defined as an activity, process or thinking activity to draw a conclusion or make a new statement based on several statements that are known to be true or considered true. Reasoning ability is a high-level thinking ability in mathematics learning. These mathematical reasoning skills are needed when understanding mathematics and developing ideas, so that students have the ability to use reasoning in patterns and properties, perform mathematical manipulation in making generalizations, compiling evidence or explaining mathematical ideas and statements. However, the mathematical reasoning skills of Indonesian students are still low. This can be seen based on the results of the PISA (*Program for International Student Assessment*) survey.

The results of the PISA study showed that Indonesia experienced a decrease in points from 403 points in 2015 to 396 points in 2018. In math competency, Indonesia experienced a decrease in points from 386 points in 2015 to 379 points in 2018 while in reading competency,

Indonesia experienced a decrease in points from 397 points in 2015 to 371 points in 2018 (Masfufah et al, 2021). Another study revealed that students' mathematical reasoning skills were low, namely research conducted by Dewi and Harahap (2019) which stated that the average score of junior high school students was 56.86 which was lower than the school's Minimum Completeness Criteria (KKM) of 75.00. The low level of students' material reasoning ability is caused by teachers who do not have learning innovations in the mathematics learning process, one example is when the teaching process the teacher still uses teaching techniques in general, namely only using the lecture method so that it appears that the teacher is in control of learning. This method makes students less active and students only record and listen, causing learning to only take place from one direction. If students' mathematical reasoning skills are low, then they will have difficulty in solving problems.

The goal of education delivered at school is to improve student achievement. However, the problem that is often faced in schools is that student achievement is still low in mathematics, this is based on data and facts from observations made by researchers from teacher interviews with the average achievement produced, which is a range of 4-5 scores and is in the category below the Minimum Completion Criteria (KKM).

One of the factors that can affect student achievement is mathematical reasoning ability Setiawan (2016) revealed that students' mathematical reasoning ability greatly affects the achievement obtained, if students' mathematical reasoning ability is low, then the achievement obtained is also low, and vice versa, if students' mathematical reasoning ability is high, then the achievement obtained will also be high.

An alternative solution in improving mathematical reasoning ability requires a learning model that is in accordance with the learning objectives in the hope that the problem can be resolved, because learning is actually involving information, making concepts, and making meaning to increase user knowledge, understanding, and skills, as well as finding time and space to learn. So that researchers chose to use the *flipped classroom* learning model with the help of interactive video media. The *flipped classroom* learning model is a model where the learning process takes place unlike in general, namely in the learning process students study the subject matter at home before class starts and teaching and learning activities in class in the form of doing assignments, discussing material or problems that have not been understood by students.

In line with this, the researcher's belief is also getting stronger on the *flipped classroom* learning model affects the mathematical reasoning ability of students, this is in accordance with the results of research conducted previously. Based on research conducted by Dewi and Harahap (2019), the results obtained state that students' reasoning abilities develop rapidly when using the *flipped classroom* learning method and this method has a positive impact on students' academics, while based on research conducted by Fedistia and Musdi (2020) it was concluded that mathematical reasoning ability increased from 47.22% to 75% by using the *flipped classroom* learning model. The application of the *flipped classroom* learning model has 3 stages, namely (1) The preparation stage, at the preparation stage the teacher prepares a learning video or other people's uploads (2) The implementation stage, at the implementation stage students are divided per group to work on assignments with material provided by the teacher and (3) The assessment stage, at the assessment stage the teacher has told students that at the end of the material there will be quizzes and tests to measure the results of the learning process undertaken. That way it will make students really pay attention to the learning process and hopefully get the desired results.

The advantages of the *flipped classroom* learning model are, (1) Students can watch the video again until they really understand the material. (2) Students can watch learning videos anywhere and anytime by having enough internet access, or by downloading the material to be more satisfied because it can be watched repeatedly. (3) Efficient, because they are required to

study the material at home and in class, students may pay more attention to their difficulties in digesting the material or their ability to solve problems related to it. While the shortcomings of the *flipped classroom* learning model, namely (1) Some students do not have devices such as laptops, computers and cell phones to access learning videos. (2) Many students do not have sufficient internet network, making it difficult to access learning videos. (3) Students may need guidance to ensure that they understand the material in the learning video.

Based on the problems and previous research described above, the researcher decided to conduct additional research by using the *flipped classroom* learning model as a stimulus to build reasoning skills in terms of students' mathematical achievement. The objectives of this study are (1) To determine the application of the flipped classroom learning model on number pattern material. (2) To determine the effect of *flipped classroom* learning on students' mathematical reasoning ability. (3) To find out the difference in mathematical reasoning ability of students who get *flipped classroom* learning in terms of student achievement with high, medium, and low categories.

RESEARCH METHODS

This research method is a quasi-experiment. The design of this research is *posttest-only control design*. According to Sugiyono (2019) the *posttest-only control* design research *design* has two classes selected randomly, the first class is given treatment (experimental class) while the second class is not given treatment (control class).

In this study, the population was all VIII grade students of MTS Al-Sa'adah as many as 49 students. While the research sample was class VIII B as many as 24 students as an experimental class and class VIII A as many as 25 students as a control class selected using *cluster random sampling* technique. The research instruments used to collect research data are test instruments and documentation. The test instrument will be tested on the upper class to test its validity and reliability. The validity test uses *Product Moment* and the reliability test uses *Cronbach's Alpha.*

Before hypothesis testing, a prerequisite test is carried out to determine whether the data results are tested using parametric or nonparametric statistics. The prerequisite test, namely the normality test, is carried out to determine whether the data that has been collected comes from normally distributed data, the normality test is carried out using the *Lilliefors test,* while the homogeneity test is a test carried out to determine whether the group of data that has been collected comes from a homogeneous data group or not, the homogeneity test is carried out using the *Fisher test* and the *Barlett* test. The *Fisher* test is used to determine whether the two groups, namely the control class and the experimental class, have homogeneous data or not, while the *Barlett* test is used to test whether the experimental group with high, medium and low categories comes from data that is homogeneous or not.

Hypothesis testing was carried out to test for differences in the mean parameters of the criterion variable between two groups using the T-test statistic, while to group data in terms of learning achievement using the ANOVA test. The hypothesis of the T-test statistic is H_0 : The average mathematical reasoning ability of experimental class students is smaller than the average mathematical reasoning ability of the control class. H_1: The average mathematical reasoning ability of experimental class students is greater than the average mathematical reasoning ability of the control class. If $t_{hitung} > t_{tabel}$, it is concluded H_0 rejected and H_1accepted, which means that there is an effect of the *flipped classroom* learning model on students' mathematical reasoning skills. For the Anova Test statistical hypothesis is H_0 : there is no difference in the average mathematical reasoning ability of students who have high, medium and low mathematical achievement after using the flipped *classroom* learning model. H_1There is a difference in the average mathematical reasoning ability of students who have high, medium and low mathematical achievement after using the *flipped classroom* learning

model. If the significance value is < 0.05 then H_0 rejected and H_1 accepted which means it can be concluded that there is an average difference in mathematical reasoning ability of students who have high, medium and low mathematical achievement after using the flipped *classroom* learning model.

RESULTS AND DISCUSSION

Based on the research results obtained, it shows that the application of the *flipped classroom learning* model has an influence on students' mathematical reasoning skills. learning in classes using the *flipped classroom* learning model is carried out 3 times a meeting. Before the question instrument is used as a test tool to determine students' mathematical reasoning ability, the instrument is tested for validity and reliability. The results of the validity test of the seven question instruments are described in the table below.

Table 1. Test Instrument Validity Test Results

Question Item	r_{hitung}	r_{tabel}	Description
1a	0,841	0,381	Valid
1b	0,826		Valid
2	-0,411		Invalid
3	0,816		Valid
4a	0,910		Valid
4b	0,864		Valid
5	0,723		Valid

The criteria for the validity of an instrument, declared valid if $r_{hitung} > r_{tabel}$ then based on Table 1, it can be seen that 6 questions are valid and 1 question is invalid because of question number 2. $r_{hitung} < r_{tabel}$. Then the reliability test is carried out. The reliability test was carried out with the number of questions to be tested as many as 6 items and can be seen in Table 2 below.

Table 2. Reliability Test Results

Question Item	Variance (σ_b^2)	Total Variance (σ_t^2)
1a	5,127	124,294
1b	8,173	
2	3,386	
3	6,513	
4a	7,053	
4b	4,684	
5	3,079	
Total Variance ($\sum \sigma_b^2$)	38,016	
r_{11}	0,931	
Criteria	$0,70 \leq r_{11} < 0,90$	
Description	High	

Judging based on Table 2. The results of the reliability test carried out get results r_{11} which is 0.931 which is included in the criteria interval $0,70 \leq r_{11} < 0,90$.

So, overall the question instrument is included in the category that has a high level of reliability, henceforth it can be used as a tool to measure the level of mathematical reasoning ability of students. So, overall the test instrument results can be declared valid and reliable.

Furthermore, after the instrument was declared valid and reliable, the researcher continued the research by taking data on students' mathematical reasoning skills to test the research hypothesis taken from class VIII B as the experimental group and class VIII A as the control group. For the average value in the experimental group obtained $\underline{x}$ = 79.91667, while for the control group obtained $\underline{x}$ = 76,16. Before testing the hypothesis, the data was first tested for normality and homogeneity. The results of the normality test carried out using the *Lilliefors* test with the results of the normality test in the experimental class and control class can be seen in table 3 below,

Table 5. Normality Test Results

Model	Significance (α)	Criteria	Conclusion
Control Class	0,200	$\alpha > 0{,}05$	Data is normally distributed
Experiment Class	0,064	$\alpha > 0{,}05$	Data is normally distributed

Source: SPSS Output Version 25

While the homogeneity test was carried out using the *Fisher* test and the *Barlett test*. The *Fisher* test is used to determine whether the two groups, namely the control class and the experimental class, while the *Barlett* test is used to test whether the experimental group with high, medium and low categories can be seen below.

Table 6. *Fisher's exact* test results

	Class Experiment	Control Class
Free degree (db)	24	25
f_{hitung}	1,006	
f_{tabel}	1,993	
conclusion	**Homogeneous Data**	

Based on table 6. it can be seen that $f_{hitung} < f_{tabel}$ so it is concluded that the two groups of data are homogeneous.

Table 7. *Barlet* Test Results

Box's M	1,404
F	0,646
df_1	2
df_2	533,610
Sig.	0,525

Source: SPSS Output Version 25.0

Seen in table 7 that if the sig value> 0.05 then it is H_0 is accepted so it is concluded that all data groups come from homogeneous data.

From the results of these two tests, the research data can be analyzed using statistical hypothesis testing. The hypothesis test used in this study is the T test and the Anova test can be seen below.

Table 8. T-test Results

Model	Mean	Std. Error	df	t	Sig
Experiment	3,75667	1,76222	47	2,132	0,038
Control		1,76210	46,930		

Source: SPSS Output Version 25.0

Based on Table 8, it can be seen if the sig value $<$ 0,05 = 0,038 $<$ 0.05 then H_0 rejected and H_1 accepted. So it can be concluded that there is an effect of the application of the *flipped classroom* learning model on students' mathematical reasoning skills. Before testing the anova test hypothesis, researchers first grouped the learning outcome scores into 3 groups, namely high, medium, and low, the scores for each category obtained the following results.

High mathematical achievement = $83 \leq skor \leq 91$

Moderate mathematical achievement = $74 \leq skor \leq 82$

Low mathematical achievement = $65 \leq skor \leq 73$

Table 10: Categories of Student Achievement

Mathematical Achievement	Student Reasoning		Total
	Control	Experiment	
High	4	8	12
Medium	10	12	22
Low	11	4	15

Table 9. Anova Test Results

Value	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1697,559	2	848,780	148,772	0,00
Within Groups	262,441	46	5,705		
Total	1960,000	48			

Source: SPSS Output Version 25.0

It can be seen in Table 9 if the sig value $<$ 0,05 = 0,00 $<$ 0.05 then H_0 rejected and H_1 accepted which means there is a difference in the average mathematical reasoning ability of students who have high, medium, and low mathematical achievement after using the *flipped classroom* learning model.

CONCLUSION

Based on the results of the research conducted at MTS Al-Sa'adah, the following conclusions can be drawn.

1. The application of the *flipped classroom* learning model to students' mathematical reasoning skills has 3 stages, namely the preparation stage, the implementation stage and the assessment stage. In the preparation stage, the teacher prepares learning videos or other people's uploads. At the implementation stage, students are divided into groups to work on tasks with material provided by the teacher. At the assessment stage, the teacher has told students that at the end of the material there will be quizzes and tests to measure the results of the learning process. That way it will make students really pay attention to the learning process and hopefully get the desired results.

2. Based on the research that has been done, the application of the *flipped classroom* learning model has an influence on students' mathematical reasoning skills. 0,038 which means the significance value $< 0{,}05$, so it can be concluded that H_0 rejected and H_1 accepted, which means that there is an influence of the *flipped classroom* learning model on students' mathematical reasoning skills.
3. After conducting the *flipped classroom* learning process, it is concluded that there is a difference in the average mathematical reasoning ability of students who have high, medium and low mathematical achievement as evidenced by the results of the anova test calculation which is obtained at 0.00 which means the significance value. $< 0{,}05$.

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