

The Impact of Discovery Learning Model Toward Reasoning Prowess of The Students Grade VIII in SMPN 7 Padang

Vika Meirian Putri, Yerizon

Department of Mathematics Education, Department of Mathematics,
Faculty of Mathematics and Natural Sciences Padang State University
Jln. Prof. Dr. Hamka, Air Tawar, Padang, 25131 Indonesia



Abstract — One of the prowess in mathematics learning that must be mastered by every student is mathematical reasoning prowess. But, the reasoning prowess of the students' grade VIII in SMPN 7 is virtually low. This is discovered when the reasearcher undertake the surveillance and provide the test that contain mathematical reasoning indicators. The students have low reasoning prowess since the students do not usually work on non routine problems and cannot accomplish their own problems by themselves. This problem can be overcome by applying the Discovery Learning model through learning. This research aims to analyze and describe whether the students' mathematical reasoning prowess who learn using Discovery Learning model is preferable than the students' mathematical reasoning prowess who learn using conventional learning at grade VIII SMPN 7 Padang. The research uses true experiment with posttest-only control design and the instrument is mathematical reasoning prowess test. The result of the analysis test obtains P-value = $0,003 < \alpha = 0,05$, which means there is an impact of the Discovery Learning model to the students' mathematical reasoning prowess that the students' mathematical reasoning prowess who learn using Discovery Learning is preferable than the students' mathematical reasoning prowess who learn using conventional learning at grade VIII SMPN 7 Padang

Keywords — Students' Mathematical Reasoning Prowess, Discovery Learning, Conventional Learning.

I. INTRODUCTION

Education can establish the quality of a nation. High or low education will impact to the high or low quality of a nation. Education will lead the nation using its knowledge to grapple all the problems in their life. Education can expand the ways of thinking and behaving through mathematics learning..

Mathematics trains the ways of thinking logically, critically, and innovatively in accomplishing all problems that are given. Someone who is capable to accomplish the problems in mathematics, will easily grapple the problems in his daily life. Students must have mathematical prowess, especially prowess to reason, communicate and accomplish the problems. [1] states about mathematics subject guidelines for junior high school which consist of eight objectives. One

of these objectives is the prowess of mathematical reasoning with indicators:

- (1) Making conjecture
- (2) Draw a conclusion of the statements
- (3) Finding the patterns in a mathematical phenomenon.
- (4) Giving the alternatives of the arguments

Reasoning is the prowess of students relating to some of the information and arguments that are needed to draw valid and accountable conclusions [2]. Furthermore [3] suggested that reasoning prowess is one of the prowess that is needed to be mastered by students to bolster their success in mathematics learning. However, to accomplish the mathematical problems we need reasoning prowess since

reasoning can help students construct their own knowledge and capacity to accomplish the mathematical problems [4]. So, reasoning prowess are needed by students at the time when they learn mathematics. In this connection, it can be noticed that the reason is a necessary mathematical tool in everyday life because there are many problems in mathematics and everyday life that require reasoning to accomplish it.

Ball, Lewis & Thamel in [5] state "mathematical reasoning is the foundation for obtaining or constructing mathematical knowledge". Students are capable to reason if they are capable to uncover mathematical patterns and traits, manipulate mathematics in general or elucidate mathematical ideas and arguments. The higher level of the students' reasoning, the faster they shall gain the learning indicator [6]. This is reinforced by [7] that mathematical reasoning prowess has the positive impacts on mathematics learning outcomes.

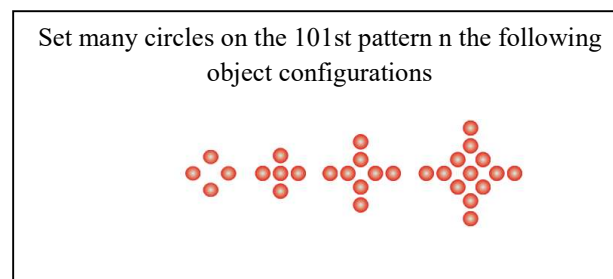
Some researches exhibit a lack of students' mathematical prowess as seen from their performance in reasoning, for instance there are still many students who have difficulty in accomplishing mathematical problems that require reasoning [8]. Furthermore, according to [9] and [10] the main factors cause the low reasoning prowess of students because they have not been capable using reasoning properly. Moreover the learning strategies undertaken by the teacher are still not capable to stimulate students honing their reasoning prowess so that students find it difficult to accomplish the problems with high levels of impediment. Students' reasoning prowess is low due to learning processes that are not denotative, and learning tends to be abstract. Learning is providing simply through an explanation by the teacher sans much attention to the possibility of applying other methods that are appropriate to the sort of the object

According to [11] the low reasoning prowess of students can be indicated in mathematics learning outcomes that are still weak. In 2011, the International level TIMMS (Trends International Mathematics Science Study) report, The ranking of Indonesia was 41 out of 45 participants. [12] added that one of the factors of the low 2011 TIMSS results achieved by Indonesia was due to students who were less trained in accomplishing the problems that demanded reasoning since learning in schools that were still teacher-centered, so students were not active (passive) and merely note the lessons that are given by the teacher.

The low reasoning prowess can also be known from the findings of research conducted by [13] that the mathematical reasoning prowess of students is low with solely around 20%

of students being capable to accomplish reasoning questions. The rest of the students are only capable to accomplish problems at a low level of understanding prowess.

The low reasoning prowess of students can also be seen at grade VIII in SMPN 7 Padang. Here is an instance of a test problem that contains indicator finding patterns in a mathematical phenomenon.



The one answer of students is as follows

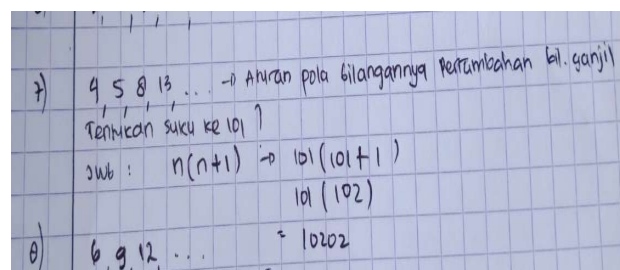


Figure 1. The answer of the students for finding patterns in a mathematical phenomenon indicator

In Figure 1 it emerges that students have not been capable to submit a statement from the pattern that is given correctly. Learners have given the statement in the form of "the rules of the pattern is odd number addition" but the statement that is put forward is not accurate and the students could not yet give the reason of the statement. According to Nasution in [14] the low mathematical reasoning of students is caused by the teacher solely explaining the subject matter is equipped with examples and exercises routine questions, but when the teacher gives the students the non-routine questions, they have impediment to accomplish that questions.

Based on the surveillance on July 23, 2019 through August 6, 2019 and conducting to the interviews with a mathematics teacher in SMPN 7 Padang, the teacher does the mathematics learning by elucidating and scribing the materials on the whiteboard, then the teacher answers questions raised by students who are still in doubt . The teacher also gives the instance of questions that are answered together and then the teacher gives exercises to do. When the

teacher gives a problem that demands reasoning prowess, students cannot accomplish the problem.

In order for the students to learn great, teaching methods must be worked out appropriately, efficiently and effectively [15]. To improve students' reasoning prowess there is a solution that can be used in the form of using the Discovery Learning model through learning. According to Balim in [16] the Discovery Learning model is a learning model that is centered on students and can train students to accomplish their own problems where students have the freedom for trying, using intuition (gestures), investigating, and obtaining the information through group discussions to find the solutions based on their activities and observations. [17] added that the Discovery Learning process is designed to make the students more active in leading learning, find and make reflections during learning activities by themselves.

According to Westwood [18] learning with the Discovery Learning model will be effective if the following things occur:

1. The learning process is structured well
2. Students have initial knowledge and skills for learning.
3. The teacher provides a support to students that is needed for investigation.

Through this learning model, students can use their ideas or information for finding the concepts or principles of learning that can improve students' mathematical reasoning prowess. Furthermore Krischer in [19] explains what students find in learning is not really new but they are trying to uncover a concept to accomplish the problems they grapple through learning. [19] describes the stages in learning discovery are: 1) providing stimulation; 2) identify the problem; 3) collecting data; 4) processing data; 5) prove and 6) make conclusions.

According to [21] the Discovery Learning model is a learning strategy that stimulates, teaches, and invites students to reason, think critically, analytically, and systematically in order to discover the answers. Then Amin in [22] added that an activity "discovery or invention" means an activity or learning that is designed making the students to uncover the concepts and principles through learning and learn how to use the idea of discovery.

Therefore, Discovery Learning is one of the learning models that can improve students' mathematical reasoning prowess. In this model, learning is centered on students, the

teacher does not provide and explain all subject matter to students but only gives a portion of the material and the rest of the students will uncover and gather it by themselves so students learning more about the concept of the lesson then if they are given questions that require reasoning, they can accomplish it easily.

Based on the results of research [13], [18], [20], [23] and [24] the Discovery Learning model can encourage or enhance students' mathematical reasoning prowess in mathematics.

The purpose of this research is to analyze and describe whether the mathematical reasoning prowess of students who learn using the Discovery Learning model is preferable than the mathematical reasoning prowess¹ of students who study with conventional learning at grade VIII in SMPN 7 Padang.

II. METHOD

The type of this research is a true experiment with a posttest-only control design to determine the impact of the Discovery Learning model to the students' mathematical reasoning prowess compared to conventional learning at grade VIII in SMPN 7 Padang.

Tabel II Posttest-Only Control Design

Class	Treatment	Posttest
Experimental	X	O ₁
Control	-	O ₂

Keterangan:

O₁ : *Posttest* that given to experiment class

O₂ : *Posttest* that given to control class

X : *Discovery Learning* model

In this research, there are two samples of classes that are taken as the control class and the experimental class. Then the Discovery Learning model is applied to the experimental class while conventional learning is applied to the control class. After the learning, those classes are given the tests of mathematical reasoning prowess to compare the results of them.

This research uses a population that is all students of grade VIII in SMPN 7 Padang. The classes are taken using simple random sampling. Class VIII. 3 is chosen as the experimental class and class VIII.2 as the control class. The independent variable in this research is learning using the Discovery Learning model, while the dependent variable is the mathematical reasoning prowess of grade VIII students in SMPN 7 Padang.

The instrument uses in this research is a student's mathematical reasoning prowess test, then the results of the mathematical reasoning prowess test is analyzed by calculating the values in both sample classes. The final test results are analyzed using the *t*-test because the data from the two samples are normally distributed. The *t*-test is intended to determine whether the mathematical reasoning prowess of students whose learning using the Discovery Learning model is preferable than the mathematical reasoning prowess that use conventional learning.

III. RESULT AND DISCUSSION

Data on mathematical reasoning prowess test results for the two sample classes is presented in Table III below.

Table III The Result Of Mathematical Reasoning Prowess Test For Sample Classes

Class	N	$\bar{x}$	S	x_{maks}	x_{min}
Experimental	32	70,12	15,93	100	43,75
Control	32	58,40	17,51	87,5	31,25

Descriptions:

N : the number of students
 $\bar{x}$: mean
S : standar deviation
 x_{maks} : maximum value
 x_{min} : minimum value

In Table III it can be seen that the average score in the experimental class is higher than the control class. The average score of the experimental class test is 70.12 while the average score of the control class test is 58.40. The highest score in the experimental class is higher than the control class. In the experimental class the highest score is 100 and in the control class the highest score is 87.5. The lowest score of the experimental class is also higher than the control class. The experimental class has the lowest score of 43.75 and the control class 31.25. The standard deviation of the experimental class is lower than the control class so it means the value of the experimental class students is more equal than the value of the control class students.

Based on the results of data analysis using the *t*-test obtained $P\text{-value} = 0.003 < \alpha = 0.05$. It means rejecting H_0 which shows the students' mathematical reasoning prowess who use the Discovery Learning model is preferable than students who use conventional learning. This is due to the impact of the Discovery Learning model that facilitates students in developing their mathematical reasoning prowess.

The data for students test outcome of mathematical reasoning prowess is presented in graphical form which can be seen in Figure 2

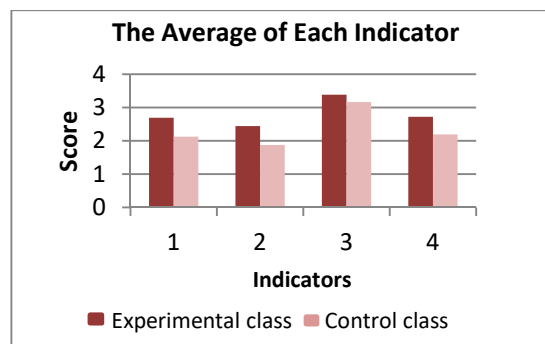


Figure 2. The graph for the average score for each indicator of mathematical reasoning prowess test.

Descriptions:

Indicator 1: Making conjecture

Indicator 2: Draw a conclusion of the statements

Indicator 3: Finding the patterns in a mathematical phenomenon

Indicator 4: Giving the alternatives of the arguments

Based on Figure 2, it can be known that the experimental class has a higher score than the control class for each indicator of reasoning prowess. So, we can conclude that the mathematical reasoning prowess of the experimental class is preferable than the mathematical reasoning prowess of the control class. This fact warrants the hypothesis that there is an impact of Discovery Learning model on the mathematical reasoning prowess so that the mathematical reasoning prowess of students who learn using Discovery Learning model is preferable than the mathematical reasoning prowess of students who learn using conventional learning at grade VIII SMPN 7 Padang.

The analysis of mathematical reasoning prowess test of students in the experimental class and control class for each indicator of reasoning prowess is:

1. Making Conjecture

From the problem, there is some information needed to make a conjecture whether Dino's rabbit can defeat Andi's rabbit or not. In this case, the students can use the relationship between the coefficient of the rabbit run speed equation with the number of cut points from known information so that it can predict whether Dino's rabbit can defeat Andi's rabbit or not if the speed of both rabbits is same and Andi's rabbit is 1 meter ahead Dino's rabbit.

Here is one of the answers from the sample class students

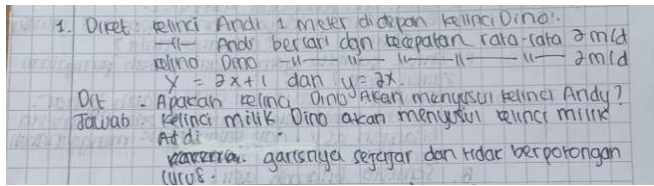


Figure 3. The answer of the students for indicator 1

In Figure 3 it can be seen that the students have made a conjecture whether Dino's rabbit can defeat Andi's rabbit and have given an explanation of his conjecture, but the explanation is incomplete. Therefore, the score for this answer is 3.

2. Draw a Conclusion from The Statements

The problem that is given to the students, requires them to conclude the number of solutions that the linear equation system has if the two equations have different gradients. One of the students' answers in the sample class for this question is that students have not been capable to conclude the number of the solutions possessed by the system of linear equations but the students have given the correct answer so the score for this answer is 2.

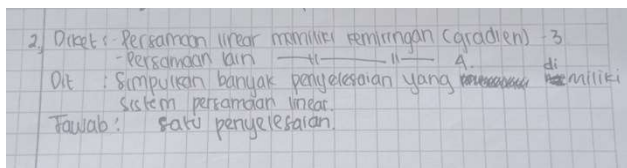


Figure 4. The Answer of the Students for indicator 2

3. Finding the Patterns in a Mathematical Phenomenon

The problem that is given to the students, requires them to determine the circumference of a building if it is formed by n . In this case, the students can use the patterns given in the form of structure 1, structure 2, and structure 3 by following the pentagons of the linear equation to calculate the circumference of pentagons.

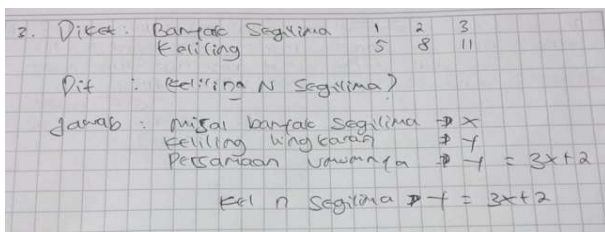


Figure 5. The Answer of the Students for indicator 3

4. Giving The Alternatives of The Arguments

The problem that is given to the students requiring them to provide alternatives to the arguments given regarding Zainul and Erik's opinion to accomplish the equation $4x + 5y = 11$.

Here is one of the answers of the sample class students for indicator 4

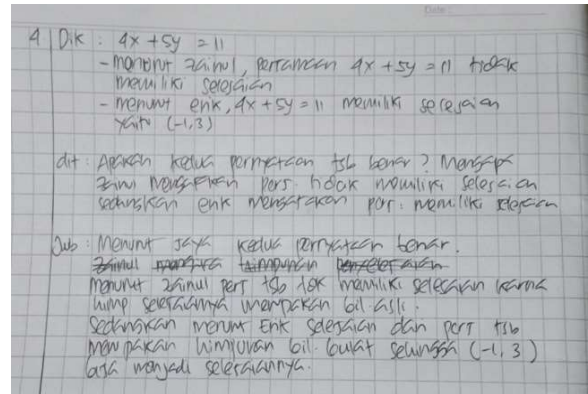


Figure 6. The Answer of the Students for indicator 4

In this question it can be seen that students have provided the correct alternative and the process of finding the answer is also correct so the score for this answer is 3.

In general, based on the description and analysis of students' answers to the indicators of mathematical reasoning above, it can be seen that overall the prowess of students by using the Discovery Learning model is preferable than the mathematical reasoning prowess of students who use conventional learning.

IV. CONCLUSION AND SUGGESTION

Based on the results of data analysis that has been done, it can be concluded that the students' mathematical reasoning prowess who learn using the Discovery Learning model is preferable than the students' mathematical reasoning prowess who learn using conventional learning.

Based on the results of this research, researcher wants to suggest to the mathematics teachers to be capable applying Discovery Learning model in mathematics learning to improve students' mathematical reasoning prowess. For other researchers who are interested in research using Discovery Learning model can try with a wider variation and can see the other prowess such as the concepts, communication, and problem solving.

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