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The Influence of Problem Base Instruction Learning Model on Reasoning Ability in Mathematics Learning On the Principle Of The Theorem Discussion Phytagoras in Class Ix Smpn I Rantau Utara

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Abstract

This study aims to determine whether the learning outcomes of students who are taught with the Problem Based Instruction learning model on reasoning abilities in learning mathematics are better than the learning outcomes of students who are taught without the Problem Based Instruction learning model on the subject of the Pythagorean Theorem. The population of this study were all grade IX students of SMP Negeri 1 Rantau Utara. The research sample was taken by random sampling as many as two classes, namely the experimental class and the control class. The experimental class was treated with the Problem Based Instruction learning model for class IX-1, amounting to thirty-two, while the control class was taught using the Conventional model for class IX-3, amounting to thirty-two.The data used are student learning outcomes collected using tests that have been tested for validity, reliability, level of difficulty and differentiating power. The data obtained were analyzed by one-sided t-test after being tested for normality and homogeneity. From the research, the average pretest value for the experimental class was 44.22 and the control was 43.91, while the average post-test value for the experimental class was 79.53 and the control was 65.00. There are pretest and posttest data for each class, then the gain is calculated, by first testing the normality and homogeneity. From the calculation of the average gain, an increase in student learning outcomes was obtained. The results of the calculation on the t-test based on the students' mathematical reasoning ability obtained thit = 8.26 and ttable = 1.699 at the significance α= 0.05 with dk = 62. These data indicate reasoning ability students' mathematics with the PBI learning model is better than the conventional learning model.This means that tcount > ttable, thus Ho is rejected and Ha is accepted. So it can be concluded that the learning outcomes of students who are treated with Problem Based Instruction learning model on reasoning abilities in mathematics learning are better than learning with conventional models on the subject of the Pythagorean Theorem.

Keywords
Learning outcomes; problem based instruction; learning model

I. Introduction

Mathematics is one of the basic sciences that is very important and main for students to learn and master. Therefore mathematics cannot be separated from everyday life. Mathematics is a subject that has different characteristics from others. Through education it is strived for students to have and have an understanding, good mastery of mathematics,

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because through mathematics lessons will provide benefits for students in the form of abilities and skills themselves.

Mathematics learning presented using Student Worksheets requires active participation from students, because the Student Worksheets are a form of teacher effort to guide students structured through activities that are able to attract students to learn mathematics. In addition, learning with Student Worksheets can make the learning process more effective as expected in each learning that is increasing the creativity of students' thinking so that learning objectives are achieved. (Tarigan, E. et al. 2020)

Facing future challenges in the era of globalization and today's sophisticated communication technology, requires individuals to have various skills and abilities. The skills and abilities that must be possessed include the ability to solve problems. In the implementation of education in schools, it is also directed at efforts to foster students' abilities, especially the ability to solve the problems they experience, especially related to problems related to the learning activities they do. The ability to solve these problems will certainly have an impact on the success of the learning activities carried out.

Abdurrahman (2001:253), argued that mathematics needs to be taught to students because: (1) always used in all aspects of life, (2) all fields of study require appropriate mathematical skills, (3) is a strong, concise and clear communication tool, (4) can be used to present information in various ways, (5) improve the ability to think logically, thoroughness, and awareness, space, and (6) give satisfaction to the effort to solve challenging problems.

In Permendiknas No. 22 of 2006, the subject of mathematics aims to make students have the ability : (1) Understanding mathematical concepts, explaining the relationship between concepts and applying concepts or logarithms, flexibly, accurately, efficiently, and precisely in problem solving, (2) Using reasoning on patterns and properties, performing mathematical manipulations in making generalizations, compiling evidence, or explain mathematical ideas and statements, (3) Solve problems that include the ability to understand problems, design mathematical models, solve problems model and interpret the solutions obtained, (4) Communicating ideas with symbols, tables, diagrams, or other media to clarify the situation or problems, (5) have an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention and interest in learning mathematics, as well as tenacity and confidence in problem solving, (Yenni dan Ragil Setyo Aji, 2016 : 73).

Based on this, reasoning ability is one of the factors that must be mastered by every student in learning mathematics. The Ministry of National Education has stated that mathematics and Mathematical material is understood through reasoning and reasoning is understood and trained through learning math material, (Fajar Shadiq, 2004: 3).

Reasoning is a process of thinking in drawing a conclusion in the form of knowledgeAccording to Jujun S. Suriasumantri (2017: 42) that reasoning produces knowledge that is associated with thinking activities and not with feelings. So reasoning is a thinking activity that has certain characteristics in finding the truth.

Sumarmo (2014), states that broadly mathematical reasoning can be classified into two types, namely: Inductive reasoning and deductive reasoning. Inductive reasoning is drawing conclusions based on observed data. Mathematical activities that are classified as inductive reasoning include: provide an explanation of the adequacy of the elements to solve the problem and give reasons for the truth of a statement, estimate answers, solutions or tendencies; interesting analogy. Activities included in deductive reasoning, one of which is carrying out calculations based on certain rules, compiling evidence, giving reasons against correct solution and logical explanation.

Weak mathematical reasoning abilities experienced by students can occur due to learning models oriented to traditional approaches that do not place and pay attention to students in the teaching and learning process. The way the teacher conveys the subject matter is not appropriate, either because the model is not in accordance with the material or because the delivery method is less pleasant. These factors cause students' mathematics learning difficulties to occur, resulting in low motivation to learn mathematics.

Efforts to overcome the weakness of mathematical reasoning abilities in the implementation of learning, of course, teachers must pay attention to and choose learning models. One of them is by applying the Problem Based Instruction learning model or problem-based learning. This learning model can foster problem solving skills through the habit of thinking and being creative in understanding and solving mathematical problems.

Based on this, researchers are interested in conducting research on the Effect of Problem Based Instruction Learning Model on Reasoning Ability in Mathematics Learning on the subject of the Pythagorean Theorem in Class IX SMPN1 Rantau Utara.

II. Review of Literature

2.1 Problem Based Instruction (PBI) Learning Model

Problem Based Instruction (PBI) is a learning model that start learning by presenting a real problem by the teacher through a number of questions in accordance with the learning material. In In this model, students are required to solve problems through various methods variety of activities such as conducting discussions and investigations. It is intended that students have the skills to solve problems and develop higher-order thinking skills in order to become good students creative, critical, and independent.

Problem-based learning is an effective approach to teaching higher order thinking processes. This learning helps students to obtain ready-made information in their minds and construct their own knowledge about the social world and its surroundings, Trianto (2009:61). This learning is suitable for developing basic and complex knowledge. The foundation of problem-based learning theory is collaborativism, a perspective which holds that students will construct knowledge by building reasoning from all the knowledge they already have and from all that is obtained as a result of interacting with fellow individuals.

Problem-based learning model is an effective approach for teaching higher order thinking. This learning forms students to process the information in their minds and organize their knowledge about the social world and its surroundings. Problem-based learning is not designed to help teachers provide as much information as possible to students.

2.2 Reasoning Ability

The foundation of mathematics is reasoning. Reasoning is wrong one basic competence in mathematics besides understanding, communication, connection and problem solving. Reasoning is also a mental process in developing the mind from some facts and principles. According to Supriyanto (2014: 34), that reasoning is an activity, a process or activity of thinking to draw conclusions or make a new statement that is true based on several statements whose truth has been proven or assumed previously.

As an activity of thinking, reasoning has the following characteristics: the following: "(1) There is a logical thinking process, in harmony so as to produce correct and valid conclusions. (2) The existence of a process of thinking activities analysis so as to lead to appropriate and valid conclusions (Cholid Narbuko, 2003: 118). R.G Soekadi (2001: 7) said "the reasoning process includes the activity of looking for propositions to be arranged

into premises, assessing the relationship between the propositions in the premises and determining their conclusions.

While the basics of reasoning whose position as a direct part of the form of reasoning are statements, because these statements are used in processing and comparisons, (Surajiyo, 2008: 32).

As'ar Musrimin (2016), argues that mathematical reasoning ability is an ability that appears in the form of: "(1) draw logical conclusions, (2) compose and test conjectures, compile direct and indirect proofs and use mathematical induction, (3) formulate counter examples (counter examples), (4) compose valid arguments. The ability to connect mathematics, for example, appears in the form of understanding the equivalent representation of the same concept.

With the ability to reason, humans can think to draw conclusions or construct new statements from several premises that are already known or considered true. In reasoning, there are two types of reasoning, namely inductive reasoning (induction) and deductive reasoning (deduction).

The implementation of mathematics learning has goals that must be achieved such as students' reasoning abilities. Reasoning is one of the basic competencies of mathematics in addition to understanding, communication, connection and problem solving. So in general, when students' reasoning abilities increase, they have the following characteristics: a logical, aligned thinking process so as to produce appropriate and valid conclusions and a process of analytical thinking activities so as to lead to appropriate and valid conclusions.

Through reasoning abilities students are possible to gain experience using the knowledge and skills they already have to be applied to solving problems that are not routine. Ability in problem solving is a skill, because it involves all aspects of knowledge (memory, understanding, application, analysis, synthesis, and evaluation) and an attitude of accepting challenges.

To overcome these problems, we need an appropriate and interesting learning model, one way to develop mathematics learning is by using the mathematics learning model, namely the problem based instruction (PBI) learning model or problem based learning.

III. Research Method

This research was conducted at SMP Negeri 1 Rantau Utara for the academic year 2021/2022. This study is an experimental study with the aim of looking at the reasoning ability in students' mathematics learning when the problem based instruction (PBI) learning model is applied to mathematics subjects on the subject of the Pythagorean theorem discussion in class IX SMP Negeri 1 Rantau Utara.

The population of this study was grade IX students of SMP Negeri 1 Rantau Utara which consisted of 10 parallel classes with a total of 310 students. The sample of this study was thirty-two (32) grade IX-1 students who were taught using a problem-based learning model, thirty-two (32) grade students were taught using the conventional learning model or lectures.

3.1 Research Instruments

The instrument used is a test in the form of a description to make it easier for researchers to find out students' mathematical reasoning abilities in solving mathematical problems through the responses of students' answers in answering test questions.

a. Data analysis technique

Calculating the Average Score with the formula:

$$\bar{X} = \frac{\sum X_1}{N}$$

Calculating Standard Deviation

Standard Deviation (sd) can be found by the formula:

$$S = \sqrt{\frac{N\sum X_1 - (\sum X_1)^2}{N(N-1)}}$$

Then calculate the variance by doubling the standard deviation.

b. Normality test

To test whether the sample is normally distributed or not, the Liliefors . normality test is used

With the formula:

$$Z_1 = \frac{X_1 - \bar{X}}{S}$$

$\bar{X}$ = Sample average

S = standard deviation

c. Homogeneity Test

The formula, as follows:

$$F = \frac{V_{besar}}{V_{kecil}}$$

d. Hypothesis testing

The hypotheses to be tested are:

a) If the data is normally distributed & the variance is homogeneous $\sigma_1^2 = \sigma_2^2$, the t formula is used:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S\sqrt{\frac{I}{n_1} + \frac{1}{n_2}}}$$ (Sudjana, 2002:239)

With:

$$S^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 2)S_1^2}{n_1 + n_2 - 2}$$

b) If the data is normally distributed & the variance is not homogeneous or $\sigma_1^2 \neq \sigma_2^{2\,t}$ test formula is used:

$$\mathbf{t} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$ (Sudjana, 2002:239)

where:

$\overline{X_1}$ = The average score of the experimental class A
$\overline{X_2}$ = The average score of the experimental class B
n_1 = number of experimental samples A
n_2 = number of experimental samples B
S_1^2 = experimental class variance
S_2^2 = experimental class variance B
S = The combined standard deviation of the two sample classes

If $t_{hit} \geq t_{tabel}$ then Ho is rejected and Ha is accepted, or
If $t_{hit} \leq t_{tabel}$ then Ho is accepted and Ha is rejected
If the data is not normally distributed, then you can use a nonparametric formula

IV. Result and Discussion

The place for the research is SMP Negeri 1 Rantau Utara for the academic year 2021/2022, which is located at Jl. Majapahit No. 19 Rantau Prapat Cendana, North Rantau District, Labuhanbatu Regency

This study uses an experimental research design, namely conducting learning using a problem based instruction (PBI) learning model in a predetermined class. This research involved class IX students of SMP Negeri 1 Rantau Utara for the Academic Year 2021/2022 which consisted of two classes, namely class IX-1 as many as 32 people and class IX-3 students as many as 32 people. The total number of students is 64 people.
Before carrying out learning, a pre-test (initial test) is carried out which is tested to determine the initial ability of students without carrying out learning. There were 32 students who took the initial ability for the PBI problem based instruction learning model class and the conventional class each. The average pre-test score in the PBI class was 44.22, and the average pre-test score in the Conventional class was 43.91.

Table 1. PBI and Conventional Class Pretest Value Data

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-tes PBI	32	20	60	44,22	13,507
Pre-tes Konvensional	32	20	60	43,91	11,828
Valid N (listwise)	32				

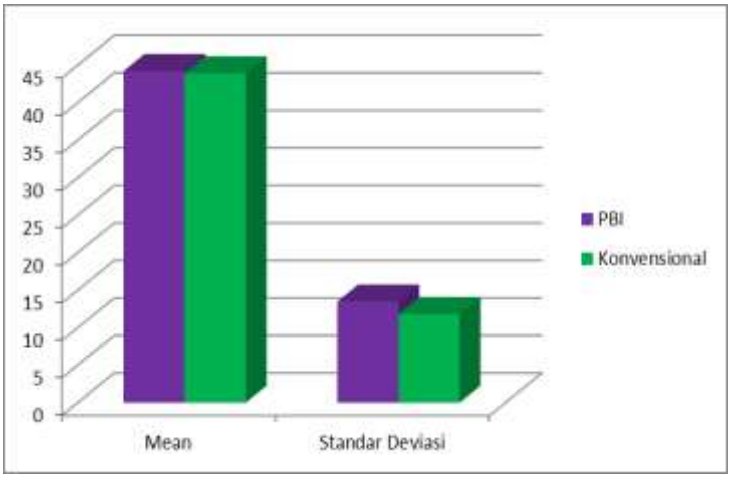

Figure 1. *Mean and Standard Deviation Diagram of Pre-test in Class PBI and Conventional Learning Models*

After the pre-test was carried out in both classes and there was no difference in the students' initial abilities, the two classes were given treatment, namely the experimental class was given the PBI problem based instruction learning model while the control class was given conventional learning. After each class received treatment, each class at the end of the lesson was given a post-test (final test) to determine the increase in students' mathematical reasoning abilities. From the post-test results, the average post-test score with PBI learning is 79.53 and the post-test average with Conventional learning is 65.00.

Table 2. PBI and Conventional Class Post-test Value Data

	N	Minimum	Maximum	Mean	Std. Deviation
Pos-tes PBI	32	65	90	79,53	6,763
Pos-tes Konvensional	32	50	80	65,00	7,296
Valid N (listwise)	32				

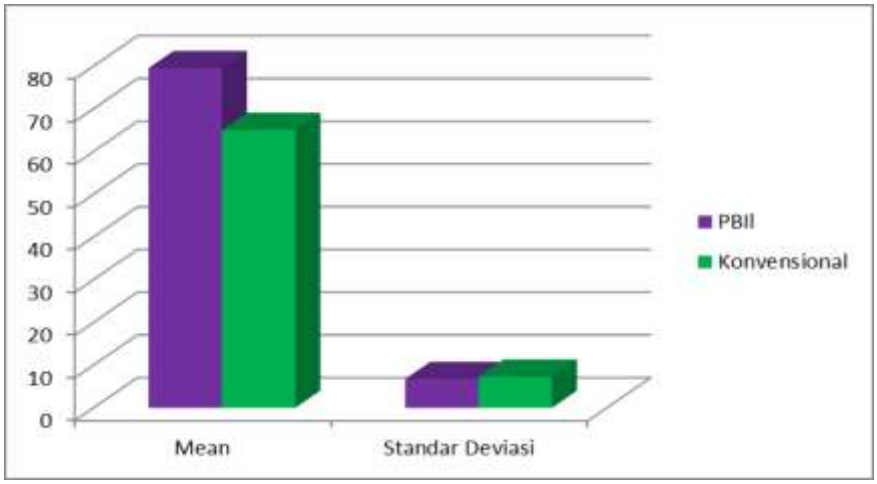

Figure 2. *Mean and Standard Deviation Diagram Post-test in Class PBI and Conventional Models*

The research instrument in the form of a student's mathematical reasoning ability test was used to determine the students' mathematical reasoning ability after studying the Pythagorean Theorem material in each class, both classes using problem based instruction (PBI) learning models and conventional classes. Before being used in research activities, this instrument was validated to students who were not the research sample.

Discussion

From the data tabulation process and data analysis to hypothesis testing, the research results obtained that the mathematical reasoning ability of students taught by the PBI learning model was better than the mathematical reasoning abilities of students taught by conventional learning models. This proves that there is an effect of the problem based instruction PBI learning model on increasing students' mathematical reasoning abilities.
The results of calculations on the t-test based on students' mathematical reasoning abilities are obtained.

The results of calculations on the t-test based on students' mathematical reasoning abilities are obtained t_{hit} = 8,26 dan t_{tabel} = 1,699 at the level of significance α = 0,05 with dk = 62. The data shows that the students' mathematical reasoning ability with the PBI learning model is better than the conventional learning model.

Judging from the aspect of students' mathematical reasoning abilities, it was found that students had more difficulty in planning, converting sentences into mathematical models. This is due to the lack of understanding of students in implementing problem solving strategies so that the final calculation results obtained are still wrong, therefore correct problem solving procedures are needed. Besides that, there are still many students who answer correctly but the problem solving steps are not yet complete, for example the known components, those who are asked, the final answer and the components of re-examination of answers, especially for conventional classes.

V. Conclusion

Based on the results of research and data analysis using the average difference test or t test, the following conclusions can be drawn: There is a difference in the mathematical reasoning ability of students who are taught using the PBI model learning with conventional learning models on the Pythagorean Theorem material in class IX of SMP Negeri 1 Rantau Prapat. Students who are taught using the PBI learning model are more active than students who are taught using the conventional learning model. The results of the analysis of the Gain data for the PBI model class with the Conventional model class using the t test obtained the value of t_{hit} = 8,26 from the distribution list t for α = 0,05, and t_{table} dan t_{count} obtained $t_{count} > t_{table}$ then Ha is accepted. Thus, it can be concluded that there is an effect of the PBI learning model on increasing students' mathematical reasoning abilities.

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