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Research Article

Improving Mathematics Reasoning Ability of Junior High School Students Using the Learning Star with a Questions Model

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Abstract.
This study examines the differences in increasing mathematical reasoning abilities using the Learning start with a question learning model and conventional learning. The research method is quantitative by way of experimental pretest-posttest control group design, which extends the one-group pretest-posttest design in two ways: a second group is added, called the comparison or control group; samples were placed randomly in each group of 83 people. The instrument used is an essay test; the questions are set in the form of mathematical reasoning abilities. Data were analyzed using inferential statistics with an independent sample t-test. The research results obtained are: The application of the LSQ learning model, most students, can solve mathematical reasoning questions correctly. The average score of students who follow the LSQ learning model is higher than the average value of students who take conventional learning; The results of the t-test explained that students who studied using the LSQ model and students who used conventional learning had significantly different improvements in their mathematical reasoning abilities. Students who learn to use the LSQ model increase their reasoning abilities more than the students who study using the conventional model.

Keywords: junior high school, learning star with a questions model, mathematics reasoning ability, student.

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1. INTRODUCTION

Reasoning can be interpreted as a person's thought process, which can conclude, thereby producing new statements that can be used to solve mathematical problems [1, 2]. The process of reasoning and mathematics are two things that cannot be separated. Mathematics can be understood through reasoning, and reasoning can be trained through learning mathematics. Thus, reasoning and mathematics are inseparable units explained that a statement that forms the basis for concluding reasoning is called a premise or antecedent, while a new statement that is a conclusion is called a conclusion or consequence [3]. Based on the description above, it can be said that reasoning is a logical thinking activity to collect facts, manage, analyze, explain, and make conclusions [4, 5].

Mathematics is a subject that must be given in schools and must be studied by every student. Studying mathematics requires seriousness because mathematics lessons are abstract and universal [6–8] stated that mathematics could underlie the development of information technology, has a vital role in various disciplines, and advances students' thinking power. All programs in information technology always use mathematics, so without mathematics, information technology science (computers) will not work.

One of the problems we often encounter is that teaching mathematics in the classroom is not very effective; the ineffectiveness of learning mathematics is most likely that the teacher always applies direct Learning in Learning [9]. Direct Learning is the delivery of material by speaking at the beginning of the lesson, explaining the material, and examples of questions accompanied by questions and answers. The teacher actively provides information, and students passively receive information. In this learning activity, students are not actively involved and do not get the opportunity to reason to convey ideas in solving problems [10, 11].

We often encounter in learning mathematics that shows less student activity. All of this is caused by the teacher's failure in delivering learning materials. Teachers cannot arouse the attention and activities of students in following lessons, especially mathematics. As a result, students' mathematical reasoning abilities, interest in Learning, and resilience to mathematics are low, causing students to be afraid, lazy, and uninterested in mathematics. The impact is on achieving indicators, which are not by what they want [12, 13].

Improving students' mathematical reasoning abilities must be assisted with appropriate learning models. The use of learning models can help students increase learning activities in class; students are no longer passive in learning activities. We know that in Learning, the teacher must be able to design Learning as much as possible to help students learn a new ability in a systematic process [14, 15]. Teachers use the right way to improve students' mathematical reasoning abilities; namely, teachers must choose the suitable learning model in Learning. A good learning model is a learning model that can develop student learning activities and can change student learning styles from passive to active [16]. One of the learning models that teachers can use to develop student learning activities from passive to active is the Learning start with a question (LSQ) learning model. Using the LSQ learning model, students quickly develop and improve mathematical reasoning ideas [17, 18].

The LSQ model type is an active learning type in asking questions; students are asked to learn the material to be studied, namely by reading first. The LSQ learning model is one of the learning models that can increase activity and create conditions for active student learning. With the LSQ model, students can convey question ideas about the subject matter before there is an explanation from the teacher [19, 20].

As the results of previous research stated that students who study using the module-assisted LSQ model, the level of mathematical communication skills is better than students who learn using conventional learning models [19]. Likewise, the results of other research that students who study using active learning start with a question model with a scientific approach assisted by handouts can increase student learning activities on the subject of quadrilaterals and triangles [21].

Observing some of the research results conducted by previous researchers using the Learning start with a question model by using some mathematical abilities. However, researchers have never found the results of other people's research using the Learning start with a question model to increase mathematical reasoning abilities. So here is the novelty of this research. This study examines the improvement of mathematical reasoning skills using the Learning start with a question model.

2. RESEARCH METHOD

2.1. Research Design

The research was designed using quantitative methods using experimental pretest-posttest control group designs by applying Learning starts with a question in mathematics learning. The pretest-posttest control group design extends the one-group pretest-posttest design in two ways: a second group is added, called the comparison or control group, and subjects were randomly assigned to each group. as described in Fig. 1.

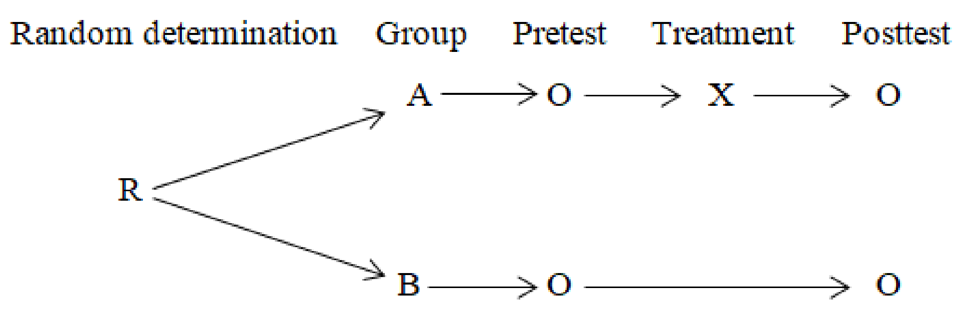


Figure 1: Design of pretest-posttest control group.

Research subjects were taken randomly and placed in both classes, namely the experimental class and the control class. Before placing the research subjects in each class, a pretest was first performed. The pretest results are known, then the research subjects are placed in each class based on the achievements obtained. Then apply the treatment (LSQ model) to the experimental class, while the control class was given ordinary Learning [22, 23].

2.2. Research Sample

The research sample was 83 people from SMP Negeri 4 Ternate City, in the 2020/2021 academic year. The 83 people were grouped into two classes; 42 people were used as the experimental class, and 41 people were used as the control class [24].

2.3. Research Instruments

The instrument used in this study was an essay test; questions are arranged based on mathematical reasoning abilities. by paying attention to several aspects in measuring students' mathematical reasoning abilities, including compiling and studying conjectures, estimating answers and solving processes, making analogies, and generalizing. The mathematical reasoning ability test in this study includes the material of straight-line equations. There are five questions in the form of descriptions with a processing time of 2×40 minutes. Implementation of the test after the entire learning process ends [25].

2.4. Data Analysis

Data were analyzed using inferential statistics in a quantitative way on the independent sample t-test. Before carrying out statistical tests, tests for normality and homogeneity of variance were first carried out [26]. The following are the steps in data processing.

1. Calculating the increase in mathematical reasoning ability can be calculated using normalized gain. Gain normalization can be obtained from the comparison of the difference between the pretest score and the posttest score with the difference between the ideal maximum score and the pretest score, with the formula:

Normalized gain (g) = $\frac{Posttest\ score - Pretest\ score}{Ideal\ max\ score - Pretest\ score}$ (1)

The gain index criteria can be seen in Table 1;

Table 1: Normalized gain score criteria.

Normalized Gain Score (g)	Interpretation
g ≥ 0.70	Tall
0.30 ≤ g < 0.70	Currently
g < 0.30	Low

1. Calculating descriptive statistics of pretest scores, posttest scores, and gain scores, including the average value.

3. result and discussion

At the end of the lesson, the researcher conducted a final test to improve students' reasoning abilities. The test is named the posttest. Some descriptions or examples of student work results on the mathematical reasoning ability test are given in the following. Here are three questions and the results of student answers, which represent several students. The evaluation results turned out that the number of students who answered the reasoning questions correctly was above the average. So, it can be said that applying the LSQ model can help students in mathematical reasoning. Here are some examples of student work on mathematical reasoning on the subject of straight-line equations as follows;

About; Find the equation of a straight line with a gradient of 4 that passes through the point R(3,2)!

The answers to the questions above can be shown in Fig. 2:

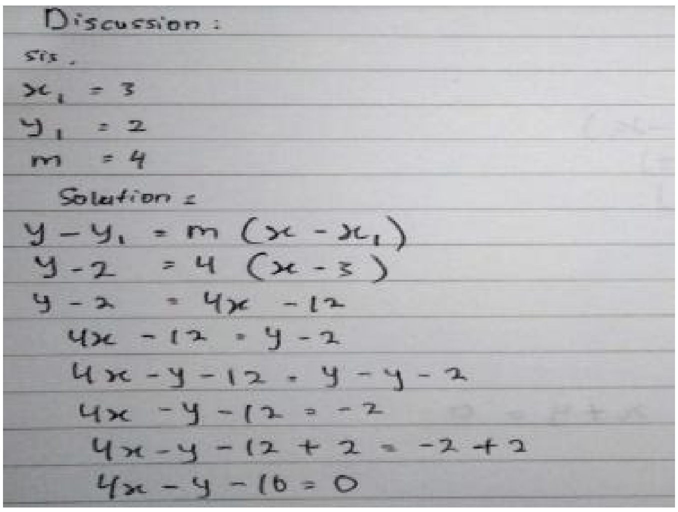
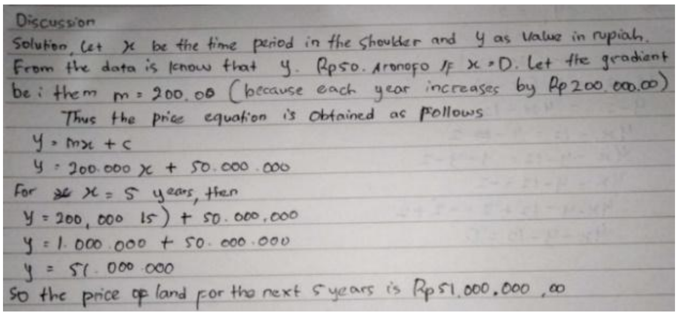


Figure 2: Example 1 test answers.

Students' answers to the questions above illustrate that students have understood the indicators of mathematical reasoning in determining the equation of a straight line with a known gradient. In solving this problem, students can complete correctly, and structured completion steps so that indicators of mathematical reasoning ability are visible.

About; It is known that a plot of land with an acquisition price of IDR 50,000,000 is estimated to experience a constant rate of increase of IDR 200,000 per year for five years. Determine the equation for the price of the land and the price of the land for the next five years.

The answers to the questions above can be shown in Fig. 3:



Discussion

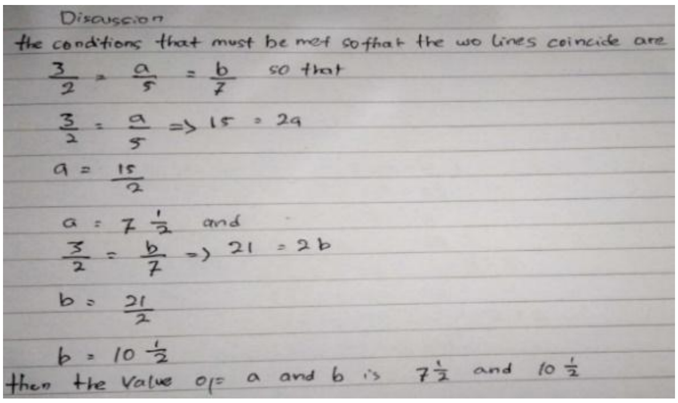
Solution, Let x be the time period in the shoulder and y as value in rupiah.
From the data is know that y. Rp50. Aronofo If x = 0. Let the gradient
be : them m = 200.00 (because each year increases by Rp200.000.00)
Thus the price equation is obtained as follows
y = mx + c
y = 200.000 x + 50.000.000
For x = 5 years, then
y = 200,000 (5) + 50.000,000
y = 1.000.000 + 50.000.000
y = 51.000.000
So the price of land for the next 5 years is Rp51.000.000,00

Figure 3: Example 2 test answers.

Students' answers to the enrichment questions above explain that students have been able to master the problem solving correctly and use structured completion steps based on indicators of mathematical reasoning ability.

About; Determine the value of a and b if the line 3x+ay+b=0 coincides with the line 2x+5y+7=0!

The answers to the questions above can be shown in Fig. 4:



Discussion

the conditions that must be met so that the wo lines coincide are

$\frac{3}{2} = \frac{a}{5} = \frac{b}{7}$ so that

$\frac{3}{2} = \frac{a}{5} \Rightarrow 15 = 2a$

$a = \frac{15}{2}$

$a = 7\frac{1}{2}$ and

$\frac{3}{2} = \frac{b}{7} \Rightarrow 21 = 2b$

$b = \frac{21}{2}$

$b = 10\frac{1}{2}$

then the value of a and b is $7\frac{1}{2}$ and $10\frac{1}{2}$

Figure 4: Example 3 test answers.

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The answer to this question shows that students master the completion indicators of mathematical reasoning abilities. In performing calculations to determine the value of a and b based on the formula, students can do it correctly based on indicators of completion of mathematical reasoning.

3.1. Mathematical Reasoning Ability

They are using pretest and posttest data on the mathematical reasoning ability test. To make it easier for us to pronounce, then the results of the N-Gain test on the pretest and posttest data can be called an increase in reasoning ability. The number of questions used in the test on mathematical reasoning abilities is eight items in the form of a description of the material, namely the straight-line equation. In order to obtain a more detailed description of the data on increasing mathematical critical thinking skills, a description of the experimental N-Gain data and N-Gain control data on mathematical reasoning abilities based on Learning is presented in Table 2.

Table 2: Description of the N-Gain data for reasoning ability mathematics based on learning.

Statistics	**N-Gain Experiment**	**N-Gain Control**
Maximum	0.26	0.21
Minimum	-0.01	0.03
Mean	0.1598	0.04631
Std. Deviation	0.05887	0.04631

Table 2 explains that students who take part in Learning using the LSQ experience an increase in their mathematical reasoning ability with an average increase (N-Gain) of 0.1598. Likewise, students who take conventional learning experience an increase in their mathematical reasoning ability with an average increase (N-Gain) of 0.04631. The data distribution on increasing mathematical reasoning abilities in each learning group has almost the same value. All of this shows that students in both learning groups experienced an increase in their mathematical reasoning abilities.

3.2. Normality Test

A normality test was conducted to see whether the sample taken from the population could be normally distributed or not [27]. From the results of the Kolmogorov-Smirnov test using SPSS output, the significance value of the two learnings, namely learning with LSQ and Conventional on N-Gain, has a significance value more significant than, as described in Table 3.

TABLE 3: Kolmogorov-Smirnov normality tests.

Class		Statistic	df	Sig.
Ngain_Score	Experiment Class	0.068	42	.200*
	Control Class	0.114	41	.200*

Based on the decision-making rules for the normality test, it can be concluded that the LSQ learning and conventional learning data are normally distributed.

3.3. Homogeneity Test

The homogeneity test was carried out to see whether the data on conventional LSQ learning had the same variance or not. Based on the significance of the Test of Homogeneity of Variances results, the significance value (Sig.) of the learning outcome variables for students who received LSQ and Conventional Learning was to have a value greater than alpha (α). As shown in Table 4 brought.

TABLE 4: Test of homogeneity of variances.

N-Gain Score			
Levene Statistic	df1	df2	Sig.
0.854	1	81	0.358

Based on the decision-making rules for the homogeneity test, it can be concluded that the variance of mathematics learning outcomes of students who receive LSQ learning with conventional Learning is the same or homogeneous. Then, the independent sample t-test was carried out concerning the results of Equal variances assumed.

3.4. Independent Sample T-Test

A t-test was conducted to see the difference in mathematical reasoning abilities between students who received LSQ learning and students who received conventional Learning [28]. The results of the independent sample t-test are presented in Table 5.

Table 5 explains the value of Sig. (2-tailed) is less than = 0.05, while tcount = 3.832. For df = 81, the value of ttable = 1.66342 is obtained. Pay attention to the value of Sig. (2-tailed) which is less than the level of significance (α), and the result of the calculation of tcount, which is more than ttable. So it can be concluded that students who study with

Table 5: Independent samples test.

		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
N-Gain Learning with LSQ and Conventional	Equal variances assumed	3.832	81	0.000	0.04438	0.01158
	Equal variances not assumed	3.843	77.486	0.000	0.04438	0.01155

the LSQ model and students who study with the conventional model have an average difference in increasing mathematical reasoning abilities.

The habit of exploring mathematical reasoning skills using LSQ learning can encourage students to reason systematically. This way of reasoning can encourage students to obtain various solutions or strategies in solving problems. These habits can be developed using aspects of reasoning ability and novelty.

Another habit that can be formed in LSQ learning activities is solving various challenging problems. Such habits can build aspects of mathematical reasoning abilities, namely students' confidence in solving problems. When students can solve problems and provide solutions, their self-confidence will grow. Such habits can be trained through the development of students' mathematical reasoning abilities in various aspects and novelties. In addition, other habits can be formed through LSQ learning, namely identifying strategies in problem-solving that can be applied. Such habits can build students' knowledge or concepts and strategies to solve problems in line with the philosophy of constructivism. Constructivism assume that students must construct their knowledge [29]. Such habits allow students to develop the potential of their critical and creative thinking skills.

Learning with LSQ can explore student activities by improving problem-solving ideas well. Activities reflecting the suitability or correctness of answers also encourage students to interpret solutions appropriately. These activities are stages in reasoning abilities, as stated by Polya [30]. It can be shown that learning with LSQ can improve mathematical reasoning abilities. Research data, in general, support the theoretical conjecture. The results showed that learning with LSQ had a significant effect on increasing mathematical reasoning abilities.

As described in the previous sub-chapter, the data analysis used in this study is based on learning using the LSQ model. Then the descriptions related to the data analysis will be linked to theoretical studies and the results of previous studies regarding mathematical reasoning abilities, where the findings and discussions will be more comprehensive. The last test results or with the name posttest were carried out to obtain information that students who studied with LSQ learning could answer or complete the questions given. The number of questions given is eight; a small number of students can complete or work on at least 4 to 5 questions. Most students can complete or answer all questions perfectly. Students have mastered the steps and indicators in solving mathematical reasoning problems, as evidenced by the results of student work.

Using N-Gain data, we can measure mathematical reasoning ability. N-Gain's calculation can be used as a measure of increasing mathematical reasoning abilities in LSQ learning. They are paying attention to the description of the N-Gain data on mathematical reasoning abilities based on Learning shown in Table 2. Students who take lessons using LSQ have an average difference in increasing mathematical reasoning abilities with students who take conventional Learning. The distribution of data owned by students from the two lessons has the same distribution of data. Thus the two learnings have increased mathematical reasoning abilities.

Table 2 also explains the comparison of the mathematical reasoning abilities of the two learnings, namely LSQ and Conventional Learning. The average value that LSQ learning is higher than conventional Learning, as shown in Fig. 2. The results of calculations using the t-test in Table 5 explain that students who study using the LSQ model significantly increase mathematical reasoning abilities with students who take conventional Learning.

4. CONCLUSION

The findings explain that students who study with the LSQ model can solve problems correctly and adequately using steps and indicators in mathematical reasoning. The analysis results reveal that the LSQ learning model can improve mathematical reasoning abilities in junior high school students. The LSQ model is suitable for junior high school students because, with the LSQ model, students can be directed quickly. Mathematical reasoning abilities in students can develop well because the steps and indicators in solving problems in mathematical reasoning always stimulate students' ideas.

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