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Improving Mathematical Reasoning Ability Students Through Strategy Learning Genius

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Abstract

This study aims to examine the differences in the improvement of mathematical reasoning abilities of students who received learning with genius learning strategies and students who received conventional learning at SMA Negeri 1 Runding, Subulussalam City. This study used a pre-test post-test control group design. The population in this study were class X students, which consisted of four classes and two classes were taken randomly to be the sample, namely class X2 as the experimental class and class X1 as the control class. The instrument used to obtain research data is in the form of a mathematical reasoning ability test. The statistical test used to analyze the data on increasing mathematical reasoning ability was the free sample t test. The results showed that the increase in the mathematical reasoning ability of students who received learning with the genius learning strategy was significantly better than students who received conventional learning.

Keywords: mathematical reasoning, genius learning strategy

INTRODUCTION

Mathematics has a great influence in advancing human thinking, thus making it one of the scientific disciplines that underlies the development of modern technology. Mathematics is one of the basic knowledge that can foster thinking and reasoning abilities for students, where both abilities are indispensable for everyday life and in the development of technology at this time. This is in accordance with the objectives of learning mathematics according to the National Council of Teachers of Mathematics (NCTM, 2000), namely to develop abilities (1) Mathematical reasoning, (2) mathematical communication, (3) Mathematical problem solving, (4) Mathematical connection, and (5) Mathematical representation.

The purpose of learning mathematics according to the NCTM clearly shows that mathematical reasoning is one of the important aspects that must be developed in the mathematics learning process. Mathematical reasoning ability is one of the mathematical abilities that play a role in honing students' thinking processes to communicate mathematical ideas. Logical, analytical, and systematic thinking activities carried out by a person to draw a conclusion based on previously obtained information are mathematical reasoning abilities (Zubainur, et al, 2020). So, reasoning is an activity, process or activity of thinking to draw conclusions or make a new statement based on several statements that are known or considered true. This statement is in accordance with Sumarmo's (2012) statement which states that reasoning is a process of making logical conclusions based on relevant facts and sources.

Meanwhile, Santrock (2010) defines reasoning as a logical thought that uses logic both induction and deduction to produce a conclusion. Reasoning is very important for students to solve a problem in everyday life, namely by linking a fact or data with other data through a valid or valid reasoning process (Shadiq, 2007). This is because the demands of students' abilities in learning mathematics are not only numeracy skills, but students are also required to have logical and critical reasoning skills in problem solving, especially problems faced in everyday life (Kusumawardani, Wardono, & Kartono, 2018).

Reasoning is one of the basic skills in mathematical literacy, because improving mathematical literacy really requires good reasoning. The term mathematical reasoning in some literature is called mathematical reasoning. Suherman (2015) states that "mathematical reasoning is reasoning about and with the object of mathematics." This statement can be interpreted that mathematical reasoning is reasoning about and with mathematical objects. The object of mathematics in question is the branches of mathematics that are studied such as algebra, geometry, calculus and others. So, mathematical reasoning is a logical thinking process about mathematical problems in order to draw the right conclusions for solving these mathematical problems and can explain or give reasons for a solution (Mahmuzah and Aklimawati, 2017).

Sumarno (2012) revealed several indicators of mathematical reasoning ability, including: (1) Drawing logical conclusions; (2) Give an explanation using pictures, facts, characteristics, existing relationships; (3) Estimating the answer and the solution process; (4) Using relationship patterns to analyze, make analogies, generalize, and compose and test conjectures; (5) Submitting an example opponent; (6) Proposing inference rules, checking the validity of arguments, and compiling valid arguments; (7) Develop direct proof, indirect proof and proof by mathematical induction. Furthermore, the National Council of Teachers of Mathematics (NCTM, 2000) describes that students are classified as having mathematical reasoning abilities if students are able to: (1) Recognize understanding and proof as fundamental aspects in mathematics; (2) Make and investigate with mathematical conjectures; (3) Develop and evaluate mathematical arguments and evidence. The indicators used in this study are indicators of drawing logical conclusions, estimating answers and solution processes, proposing inference rules, checking the validity of arguments and compiling valid arguments, and providing explanations using pictures, facts, properties, and existing relationships.

Mathematical reasoning ability is needed by students both in the process of understanding mathematics itself and in everyday life. Especially in everyday life, the ability to reason is useful when solving problems that occur both in the personal, community and other wider social institutions. (Mahmuzah and Aklimawati, 2017). According to the standards of the NCTM Curriculum, the main objective of learning mathematics should be to encourage students' belief that mathematics makes sense, to increase students' sensitivity to the power of mathematics, and to have confidence in students' thinking abilities.

However, the reality on the ground is just the opposite. So far, many students think that mathematics is an abstract subject, and it is difficult, even frightening (Aisyah, et al. 2015). Students assume that mathematics is a science that is difficult to understand, uninteresting, boring and everything that creates a negative picture of mathematics itself. This will have an impact on the low mathematical ability of students, especially the ability to think and reason so that student learning outcomes will also not be achieved as expected. Such incidents occur because many groups such as students and also the public do not realize that mathematics has tremendous benefits in everyday life, making us more patient, and helping us become more thorough, careful and not careless individuals (Saleh . et al, 2021).

The lack of activeness of students in thinking when the learning process takes place and still considers mathematics as a complicated subject is one of the causes of the low mathematical reasoning ability of students. The problem of the low mathematical reasoning ability of students usually tends to be caused by the use of inappropriate learning strategies, so changes need to be made. One of them is by applying appropriate and suitable learning strategies in developing students' mathematical reasoning abilities. Teachers must have the right strategy in building and improving students' reasoning, one way is to use the genius learning strategy.

Genius learning is a learning strategy that is packaged in such a way that uses knowledge from various disciplines such as knowledge about how the brain works, how memory works, neuro-linguistic programming, motivation, self-concept, personality, emotions, feelings, thoughts, metacognition, learning styles, multiple intelligences or multiple intelligences, memory techniques, reading techniques, note-taking techniques, and other learning techniques (Gunawan, 2012).

Gunawan also explained that there are nine main principles in the learning process with the genius learning strategy, namely: (1) The brain develops optimally in an environment rich in multisensory stimuli and thinking challenges; (2) The amount of expectation is directly proportional to the results achieved; (3) The learning environment is an environment that provides high challenges but with a low level of threat; (4) The brain is in dire need of immediate feedback and has many options; (5) Music helps the learning process because music helps to charge the brain, relaxes the brain so that the brain is ready to learn, and music can be used to carry information that wants to be entered into memory; (6) There are various pathways and different types of memory that

exist in our brain, so that by using special techniques or strategies, the ability to remember can be improved; (7) Physical and emotional conditions are interrelated and cannot be separated, so they must really be considered in order to obtain maximum learning outcomes; (8) Each brain is unique with different development capacities for each individual; (9) Although there are differences in function between the left brain and right brain, both can work together in processing information.

The genius learning strategy designs the classroom atmosphere to be fun, which can increase student activity, make learning more attached and learn optimistically, because learning events and student activity can serve as reinforcement for the subject matter provided. Such learning activities are expected to be very likely to improve students' mathematical abilities, especially mathematical reasoning abilities. Therefore, in this study, we will examine more deeply about the differences in the improvement of mathematical reasoning abilities of students who receive learning with genius learning strategies and students who receive conventional learning at SMA Negeri 1 Runding, Subulussalam City.

RESEARCH METHODS

This research is an experimental research because the researcher gives treatment to the research sample to further want to know the effect of the treatment. The treatment in question is learning with the genius learning strategy in the experimental class and conventional learning in the control class. The approach used in this research is a quantitative approach. Meanwhile, a quantitative approach was used because this research was conducted to prove the research hypothesis that was formulated based on the existing theory, namely about the differences in increasing mathematical reasoning abilities between students taught with genius learning strategies and those taught with conventional learning. Sugiyono (2016) states that quantitative research methods are used if you want to know the effect of certain treatments on others.

The population in this study was class X students at SMA Negeri 1 Runding, Subulussalam City. This population was chosen because the school is one of the schools that is open to the latest innovations so that it supports researchers in conducting research. Class X at SMA Negeri 1 Runding, Subulussalam City is divided into four classes and from the four classes, two classes are taken randomly to be used as research samples, namely as an experimental class and as a control class. The experimental class is a class that is applied to learning with a genius learning strategy and the control class is a class that receives ordinary or conventional learning.

The random selection stage was possible because based on information from the X grade mathematics teacher at SMA Negeri 1 Runding Kota Subulussalam that the distribution of students in each class was evenly distributed or in other words the abilities of students in the four classes were almost the same or equivalent so that the sample selection in this study was numbered. each class on paper and then a lottery is done. A class draw was conducted to determine the experimental class and the control class. From the results of random sampling, the class that became the sample in the study was class X2 as the experimental class and class X1 as the control class.

The test instrument used to measure mathematical reasoning ability in this study was in the form of a set of mathematical reasoning ability questions in the form of a

description. Giving description questions is intended to see students' thinking and reasoning processes, accuracy, and systematics in preparing answers that can be seen from the steps for solving the questions made.

Tests are carried out at the beginning and at the end of the learning process. The initial test is given to see the equality of the initial reasoning abilities of the two classes while the final test is given to determine whether there is an increase in students' mathematical reasoning abilities after learning with the genius learning strategy and to find out how much the increase in students' mathematical reasoning abilities will be seen from the normalized gain. Processing of data on the results of the mathematical reasoning ability test using an independent sample t test with the help of Microsoft Office Excel 2007 program and version 16 of the Statistical Package for the Social Science (SPSS) software.

RESULTS AND DISCUSSION

The results of the initial test or pretest both descriptively and statistically showed that there was no difference in the students' initial mathematical reasoning abilities between the experimental class and the control class. Following are the results of descriptive data processing on the initial test of the reasoning abilities of students in both classes:

Table 1
The results of descriptive data processing of the initial test of students' reasoning abilities experimental class and control class

	Group	N	Mean	Std. Deviation	Std. Error Mean
Value of	Eksperimen	30	16,00	7,474	1,365
	control	30	15,83	6,833	1,248

Based on table 1, it can be seen that the average initial test score for the experimental class is 16.00 and the control class is 15.83. These results indicate that the average initial test results of students in the experimental class are relatively the same as the average initial test results of students in the control class. However, to find out the equivalence or similarity of the students' initial mathematical reasoning abilities from the two research sample groups, it is necessary to carry out statistical analysis tests which include: normality test, homogeneity test of variance, and average difference test. The test of the difference in the mean of the initial test results was carried out to prove that there was no significant difference between the initial reasoning ability of the experimental class and the control class. With a significance level of $\alpha = 0.05$, the test criteria are accept H_0 if sig. 0.05 (Mahmuzah, 2016). The following presents the results of statistical test data on the initial test of students' reasoning abilities in both classes.

Table 2
The Results Of The Statistical Test Results Of The Initial Test Of
Students' Reasoning Abilities Experimental
Class And Control Class

Class	Kolmogorov-Smirnov ^a			Levene test		Uji t sampel bebas	
	Statistic	Df	Sig.	Levene Statistic	Sig.	t	Sig. (2-tailed)
Exsperimen	0,156	30	0,062	3,315	0,074	0,090	0,928
Control	0,203	30	0,093				

Normality test was performed using the Kolmogorov-Smirnova test. Table 2 shows that the initial test of mathematical reasoning ability, both the experimental class and the control class, has a sig value. which is greater than $= 0.05$, namely 0.062 and 0.093. This means that the initial test data for the experimental class and the control class are normally distributed or both classes come from a normally distributed population. The same thing also happened to the homogeneity of variance test using the Lavene test. Table 2 also shows that the value of sig. obtained more than $= 0.05$ that is 0.074, so it can be concluded that the initial test of the two classes has a homogeneous variance.

Because the initial test data is normally distributed and has a homogeneous variance, then further statistical tests are carried out, namely the free sample t test to determine the similarity of the initial abilities of students in the two classes. Table 2 shows the value of sig. for the average difference test, namely the free sample t test is also more than $= 0.05$, namely 0.928 so that H_0 is accepted and H_a is rejected. This means that there is no significant difference between the average initial test of students' mathematical reasoning abilities taught using the genius learning strategy and the average initial test of students' mathematical reasoning abilities taught using conventional learning. So, it can be concluded that these two classes have the same initial reasoning ability before being given treatment, namely learning with genius learning strategies in the experimental class and conventional learning in the control class.

Different results were obtained after the learning process took place. The reasoning ability in both classes was equally improved when compared to before the learning process. However, the results of the final test or posttest of the experimental class students' reasoning abilities were better than those of the control class students. The following presents the results of descriptive data processing of the final test of students' reasoning abilities in both classes:

Table 3
The results of descriptive data processing of the reasoning ability final test
experimental class and control class

	Group	N	Mean	Std. Deviation	Std. Error Mean
Value	Experimen	30	80,67	11.351	2,072
	control	30	72,67	8.172	1,492

Based on table 3, it can be seen that the average final test score of the experimental class students' reasoning ability is higher than the control class, which is 80.67, while the control class is 72.67. These results indicate that the average final test result of the experimental class students' reasoning ability is better than the average control class student's reasoning ability final test result. However, to find out whether there are differences in the increase in students' mathematical reasoning abilities from the two research sample groups, descriptive analysis tests and statistical tests were carried out on the average value of N-gain or normalized gain. The average normalized gain is a description of the increase in students' mathematical reasoning abilities after participating in learning, both those who follow learning with the genius learning strategy (experimental class) and those who follow conventional learning (control class). Following are the results of the descriptive analysis of the N-gain value of students' reasoning abilities in the experimental class and control class:

Tabel 4
The value of N-gain reasoning ability experimental class and control class

	Group	N	Mean	Std. Deviation	Std. Error Mean
Value	Experimen	30	0,779	0,119	0,022
	Control	30	0,680	0,075	0,014

The results of the descriptive analysis in table 4 also show that the average Ngain of the experimental class is better than the average N-gain of the control class, which is 0.779, while the control class is 0.680. Based on the normalized gain criteria, the average N-gain of the experimental class is included in the high classification because it is > 0.7 , while the control class is classified as moderate (Irwan, 2011). However, to prove that the increase in the reasoning ability of the experimental class students is significantly different from the control class, it is necessary to carry out further statistical tests. Statistical tests to be carried out include normality test, homogeneity of variance test, and average difference test. The results of the calculation of the average difference test were carried out using the free sample t test at a significance level of $\alpha = 0.05$ with the test criteria, namely accept nilai sig. $\geq \alpha$ (Mahmuzah, 2016). The following presents the results of statistical test data on the N-gain value of students' reasoning abilities in the experimental class and control class:

Table 5
The results of statistical test data for the value of N-gain the reasoning ability of the experimental class and control class students

class	Kolmogorov-Smirnov ^a			Uji t sample sample			
	Statist ic	Df	Sig.	Levene Statistic	Sig.	t	Sig. (2- tailed)
Eksperime n	0,120	30	0,200*	6,854	0,01 1	3,882	0,000

Control	0,158	30	0,053
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Table 5 shows that, for the normality test (Kolmogorov-Smirnov^a) value of N-gain mathematical reasoning ability both experimental class and control class has a sig value. more than $\alpha = 0,05$ is 0,200 and 0,053. This means that the N-gain data for both classes are normally distributed or both classes come from a normally distributed population. Because the data is normally distributed, then the homogeneity test is then carried out using the Lavene test.

The results of the homogeneity test of the variance of the two classes showed that the value of sig. is less than $\alpha = 0,05$ is 0,011, so it can be concluded that the final test of both classes has a non-homogeneous variance. After knowing the data is normally distributed and the variance is not homogeneous, then the next statistical test to find out the difference in the average mathematical reasoning ability of the two classes is the free sample t test with the assumption that the variance is not the same.

The results of the free sample t-test with the assumption that the variances are not the same in table 2 show the sig value less than $\alpha = 0,05$ is 0,000, so H_0 is rejected or accepted H_a . This means that the increase in the mathematical reasoning ability of students who receive learning with genius learning strategies is better than students who receive conventional learning.

The genius learning strategy positions students as the center of the learning process or as educational subjects. The students' learning process of mathematics will be more relaxed, so that students are more interested in learning and students feel more comfortable in participating in the teaching and learning process of mathematics. In addition, learning by applying the genius learning strategy will help students to understand their strengths and strengths according to their respective learning styles, with the hope that students will become active, creative and independent, so that they can obtain maximum results at the end of learning. . Based on the results of research and discussion, it can be concluded that the increase in

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the improvement of students' mathematical reasoning abilities who received learning using the genius learning strategy was significantly better than students who received conventional learning. This can be shown from the average N-gain value of the experimental class which is higher than the control class. This result is also evidenced by the results of the free sample t test which also shows the sig value. more or less than $\alpha = 0,05$ is 0,000, so that H_0 is rejected or accepted H_a .

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