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THE MATHEMATICAL CONNECTION ABILITY OF JUNIOR STUDENT'S THROUGH THE SCIENTIFIC APPROACH AND GUIDED INQUIRY METHOD

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Abstrak

This study used the pre-test post-disigned quasi-experimental method. The purpose of this study was to find out the achievement and improvement of mathematical connection ability of students whose learning using the scientific approach and guided inquiry method was better than those using the scientific approach only. This research was conducted at the junior high school level. The instrument used in this study was a test of mathematical connection ability. The results showed that learning using the scientific approach and guided inquiry method was better than those using the scientific approach only in improving students mathematical connection ability, both from the significance of t-test posttest 0.017 and from the results of the t-test n-gain significance of 0.024. For the difficulty of solving the problem of experimental class mathematical connection ability lies in the percentage of questions number 6 which is 46.9% with indicators applying the relationship of mathematics to everyday problems, while the percentage of achievement in the control class is very low in question number 5 is 46.1% with indicators look for the relationship of one procedure to another in equivalent representations. Learning using the scientific approach and guided inquiry method makes creative students associate concepts or mathematical procedures appropriately.

Keywords: Mathematical Connection Ability, Scientific Approach and Guided Inquiry Method.

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INTRODUCTION

Mathematical connection ability are very necessary and mastered by students at every level of education (Anita, 2014; Harahap, 2015; Hendriana, Rahmat, & Sumarmo, 2014; Hendriana & Sumarmo, 2014; Heryani & Setialesmana, 2017; Kartika, Tandililing, & Bistari, 2016; Lestari, 2014; NCTM, 2000; Prihandhika, 2017; Siagian, 2016). Mathematical connection ability aim to understand a concept to improve other scientific disciplines through the linkages between mathematical concepts and conceptions from other scientific disciplines (Harahap, 2015; Hendriana et al., 2014; Siagian, 2016). The importance of having mathematical connection ability is contained in the objectives of secondary school mathematics learning, namely: understanding mathematical concepts, explaining the interrelationships between concepts and applying concepts or algorithms flexibly, accurately, efficiently, and precisely in problem solving (Anita, 2014; NCTM, 2000).

Mathematical connection ability in junior high school students are still very low (Kartika et al., 2016; Prihandhika, 2017; Siagian, 2016; Yenni & Komalasari, 2016), students have difficulty connecting between concepts that students have previously known with new

concepts that students will learn (Ainurrizqiyah, Mulyono, & Sutarto, 2015; E. Setyaningsih & Widjajanti, 2015). Students are not accustomed to working on non-routine questions in connecting between mathematical concepts.

Based on the results of daily evaluations of class VIII B SMP Negeri 2 Cilamaya Kulon Karawang on the material of the Pythagorean Theorem consisting of 38 students, the average score obtained by students was 37.50 from a maximum score of 100. Students in general were less able to associate mathematical concepts or connecting mathematical concepts with other fields of science. This is in line with the teaching experience of writers in class VIII at SMP Negeri 2 Cilamaya Kulon, the researcher explained that the mathematical connection ability of junior high school students is still lacking, students rarely conduct group discussion activities. In group discussion activities there were some students who had difficulty in relating concepts between mathematics, students rarely exchanged opinions with other students, students were only able to solve similar questions with the questions exemplified by the teacher, and when they got different types of questions students tended to give up immediately, wanted a teacher who solved the problem.

Mathematical connection ability are mathematical abilities that students need to have and develop in connecting students' conceptual and procedural knowledge to associate mathematical concepts both between mathematical concepts, concepts in everyday life and linking mathematical concepts to other fields outside mathematics (Anita, 2014; Harahap, 2015; Kartika et al., 2016; Putri & Santosa, 2015; L. Setyaningsih, Asikin, & Mariani, 2016; Siagian, 2016). Indicators of mathematical connection abilities used in this study are: (1) understanding representations equivalent to a concept, process, or mathematical procedure; (2) looking for relationships of various representations of concepts, processes, or mathematical procedures; (3) Understand the relationship between mathematical topics; (4) applying mathematics in other fields or in everyday life. Common mistakes that often occur in solving math problems include mistakes in understanding mathematical concepts and formulas, calculation errors, errors in understanding symbols and signs, errors in choosing and using settlement procedures (Hanipa & Sari, 2019).

To overcome the underdevelopment of students' mathematical connection ability, a teacher must master the material to the maximum, able to create learning situations that can motivate students to play an active role in the learning process, and be able to guide students to master mathematical connection ability. In order for students' mathematical connection ability to develop optimally, students must have an open opportunity to think and be creative in understanding various concepts. To improve students' mathematical connection ability, an approach and learning model is needed that can support the implementation of learning that places students as subjects of learning. One approach that can be used is the scientific approach and guided inquiry method.

The scientific approach is a learning approach that is designed so that students actively construct concepts, laws or principles through the stages of observing, asking questions, collecting data with various techniques, processing information, and communicating concepts, laws or principles found (Fauziah, Abdullah, & Hakim, 2013; Juwariah, Atmojo, & Usodo, 2015; Ramziah, 2016; Rudyanto, 2014). While the guided inquiry method is a learning method that aims to enable students to find and use various sources of information and ideas to improve thinking ability, students not only act as recipients of subject matter from the teacher, but with guidance from the teacher they can find the core of the subject matter (Amelia, 2015; Hilman & Retnawati, 2015; Suhadak & Wutsqa, 2014; Widiastuti & Santosa, 2014). The scientific approach and the method of guided inquiry are learning processes that emphasize the discovery of concepts or principles that encourage students to develop thinking

ability. The main advantage of the scientific approach and the guided inquiry method is to train students to learn independently, train students' thinking ability, and actively involve students in learning activities to find themselves and solve problems without the help of others.

The purpose of this study was to determine the achievement and improvement of mathematical connection ability of students whose learning using the scientific approach and guided inquiry method was better than those using the scientific approach only.

METHOD

This study uses the quasi experimental design method in two different classes which are divided into experimental classes and control classes with randomly determined. The experimental class consists of 38 students taught with a scientific approach and guided inquiry method, while in the control class there are 38 students taught with a scientific approach to learning treatment. Before getting treatment, the two classes are given the initial test (pretest) and after getting treatment the two classes are given the final test (posttest).

The population in this study were all eighth grade students of SMP Negeri 2 Cilamaya Kulon Karawang. With the sample subjects were two classes VIII, while the sample was chosen 2 classes randomly where the experimental class used learning with a scientific approach and guided inquiry method and the control class used a scientific approach only. Class VIII B as the experimental class and class VIII C as the control class. This research was conducted for 5 weeks in SMP Negeri 2 Cilamaya Kulon Karawang.

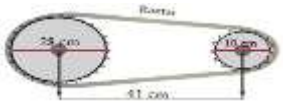
Before getting treatment, both classes were given initial tests (pretest) in order to determine the students' initial mathematical connections before treatment. Whereas after getting treatment the two classes were given the final test (posttest) with the aim of the junior high school students' mathematical connection ability in the experimental class better than the control class. The instrument used is a set of tests in the form of a description in the form of 6 test questions for mathematical connection ability. Before the test of the mathematical connection ability is carried out, first test the validity, reliability, index of difficulty and differentiation of the test instrument. Test the validity by using the Product Moment correlation formula and test reliability with the Alpha formula. To analyze and provide conclusions from the data that has been obtained in the study used a statistical test with a two-mean difference test, but beforehand the normality test was done before.

Examples of test questions for mathematical connection ability for junior high school in this study are as follows:

1. Indicator: Look for relationships with one procedure with equivalent procedures in representation
   Question:
   The following is given a picture of three squares of the same size. Inside the square is a circle according to the picture next to this.

   From the picture next, specify the widest shading area in several ways (representation)!
2. Indikacor: Apply a mathematical relation to the issue of a day
   Question:



The center of the gear axis on Sport bikes is 41 cm. Rear gear diameter 10 cm and front gear diameter 28 cm. What is the closest approximate length of the connecting chain of the two gears?

RESULTS AND DISCUSSION

RESULT

The data obtained from this study are quantitative data. Quantitative data were obtained from the results of pretest, posttest, and normalized gain of mathematical connection ability of students in the experimental class and control class. To find out the achievement of mathematical connection ability between students in the experimental class and the control class is calculated based on the posttest score. To determine the increase in mathematical ability between students in the experimental class and the control class was calculated based on normalized n-gain. Mathematical connection ability of students in the experimental class and controls before and after treatment on students can be seen from the pretest and posttest scores.

Before being analyzed it will be presented first descriptive ability scores pretest, posttest, and n-gain in the following Table:

Table 1. The Mathematical Connection Ability Result

Research Class	Pretest			Postest			N – Gain	
	$\bar{x}$	SD	SMI	$\bar{x}$	SD	SMI	$\bar{x}$	SD
Experimental	10.921	3.035	36	24.105	3.805	36	.523	.155
Control	10.737	2.984	36	22.211	3.793	36	.453	.147

Based on Table 1 above, it can be concluded that the initial ability of the mathematical connections between the two classes is not much different. After learning, the experimental class's mathematical connection ability is better than the control class, meaning that the increase in mathematical connection ability using the scientific approach and guided inquiry method is better than the one using the scientific approach.

In the analysis of the initial test data (pretest), after the normality test was obtained, the significance value of the experimental class was .061 and the significance value of the control class was .086 so that the two classes were normally distributed, then continued with the variance homogeneity test. The variance homogeneity test results obtained a significance value of .826 so that the data is homogenous. Furthermore, two similarity tests were carried out on average using SPSS 20.0 for Windows software, the following results were obtained:

Table 2. The Similarity of Significance Test of The Pretest Average Scores

Research Class	N	$\bar{x}$	SD	Sig.	Interpretation
Experimental	38	10.921	3.035	.79	H_0 accepted
Control	38	7.737	2.984		

Based on Table 2, the significance value of the two-party t-test is .79, where the significance value is > .05 so that H_0 is accepted. So it can be concluded that there is no difference in the

initial ability of mathematical connections that will use the scientific approach and guided inquiry method with those who will use the scientific approach only.

To find out whether there is achievement of students' mathematical connection abilities, post-test is done after learning is given. The following is a table of results of the normality test and post-test homogeneity using SPSS 20.0 for Windows software.

Table 3. The Normality Test and Homogeneity Result of Postest Score

Type of test	Experimental Class			Control Class		
	$\bar{x}$	SD	Sig.	$\bar{x}$	SD	Sig.
Normality	24.105	3.805	.11	22.211	3.793	.055
		Normal			Normal	
Homogeneity	Levene Statistic = .002 Significance = .964 Homogeneous					

Based on Table 3, the significance value of the normality test obtained from the experimental class is .11 and the significance value of the control class is .055, where both classes have significance > .05 so that H_0 is accepted. This means that posttest data samples in the experimental class and control class are normally distributed. Then the variance homogeneity test was performed using the Levene Statistic test on the final test score. In Table 3 the significant value of the homogeneity test is .964, which means the variance of the two sample groups is homogeneous.

Furthermore, a significant test of the difference between the two posttest average mathematical connection ability using the one-party t test is the right-hand test using the Independent Sample T-Test with the second assumption of homogeneous variance (equal varians assumed) with a significance level of .05. In this case the researcher uses the right-hand test with the aim to find out which learning is better.

The test criteria are as follows:
If the value is Sig. (1 - tailed) > .05 then H_0 is accepted.
If the value is Sig. (1 - tailed) ≤ .05 then H_0 is rejected.

After testing the two differences the posttest average mathematical connection ability using SPSS 20.0 for Windows software, the results are:

Table 4. Test Results Differences in Two Average Postest Score

Research Class	N	$\bar{x}$	SD	Sig. (2-tailed)	Interpretation
Experimental	38	24.105	3.805	.33	H_0 rejected
Control	38	22.211	3.793		

Based on the results in Table 4, it can be seen that the significance (2-tailed) value is .033. "Because to test the hypothesis of one party (1-tailed) then the value of significance (2-tailed) must be divided in two" (Uyanto, 2009). By looking at the table above, the sig value. (1 - tailed) is $\frac{.033}{2} = .0170$. Because the significance value (1-tailed) < .05 then H_0 is rejected. Thus it can be concluded that there is an achievement of mathematical connection ability of

students whose learning uses the scientific approach and guided inquiry method is better than those who use the scientific approach only.

Data analysis n - normalized gain was conducted to determine the increase in mathematical connection ability between those using the scientific approach and guided inquiry method with those using the scientific approach only. The following is a table of the results of the normality test and the index n-gain homogeneity test normalized using SPSS 20.0 for Windows software. The results are as follows:

Table 5. The Results of Normality Test and Homogeneity of N-Gain Index Normalized

Type of test	Kelas Eksperimen			Kelas Kontrol		
	$\bar{x}$	SD	Sig.	$\bar{x}$	SD	Sig.
Normality	.523	.155	.102	.453	.147	.569
		Normal			Normal	
Homogeneity	Levene Statistic = .151 Significance = .698 Homogeneous					

Based on Table 5, the significance value of the experimental class is .693 and the significance value of the control class is .362, where both classes have sig values. > .05 so that H_0 is accepted. This means that both samples come from populations with normal distribution. The homogeneity test was then carried out to find out whether the data variants from the analyzed samples were homogeneous or not. The significance value of the homogeneity test is .829, where the value is sig. > .05 so that H0 is accepted. Thus, the variant of the experimental class and the homogeneous control class.

Because both classes are normally distributed and have a homogeneous variant, then the two difference test is carried out using the one-party t-test, the right-hand test, because to see which learning is better. For the test of the difference of two, the average one party uses a significance level of .05.

After testing the two differences the posttest average mathematical connection ability using SPSS 20.0 for Windows software, the following results are obtained:

Table 6. Significant Test Results Difference in Two Average N - Gain Indexes Normalized

Research Class	N	$\bar{x}$	SD	Sig. (2-tailed)	Interpretation
Experimental	38	.523	.155	.047	H_0 rejected
Control	38	.453	.147		

Based on the results in Table 6, it can be seen that the sig (2-tailed) value is .047, then the significance value (1 - tailed) is .024. Because the significance value (1-tailed) < .05 then H_0 is rejected. Thus it can be concluded that there is an increase in mathematical connection ability of students whose learning uses the scientific approach and guided inquiry method is better than those who use the scientific approach only.

An overview of students 'performance in solving questions-questions about students' mathematical connection ability can be seen from the results of the average posttest obtained at the end of learning. The posttest results of mathematical connection ability are presented in the recapitulation of Table 8 as follows:

Table 7. The Average Value of Postes Results of Students' Mathematical Connection Ability

Question Number		1	2	3	4	5	6
Experimental Class	$\bar{x}$	4.63	4.39	4.5	4	3.76	2.82
	%	77.2	73.2	75	66.7	62.7	46.9
Control Class	$\bar{x}$	4.13	3.89	3.79	3.97	2.76	3.66
	%	68.9	64.9	63.2	66.2	46.1	61

Based on Table 7, it can be seen the general description of the posttest results of students' mathematical connection abilities in the experimental class and the control class. On the mathematical connection ability the average posttest value in the experimental class is greater than the average posttest value in the control class. Thus, the achievement of experimental class mathematical connection abilities that use the scientific approach and guided inquiry method is better than the control class learning that uses the scientific approach only.

For the difficulty of solving the problem of experimental class mathematical connection ability lies in the problem number 6 with the percentage of achievement that is 46.9%. While the percentage of achievement in the control class was very low in question number 5 with a percentage of achievement of 46.1%. It can be concluded that the two classes have the same difficulty in indicators of different mathematical connection abilities. Overall students have difficulty in applying the relationship of mathematics to everyday problems and looking for relationships with one procedure with equivalent procedures in representation.

The following are the difficulties experienced by the experimental class students in solving the problem of mathematical connection ability presented:

Table 8. Recapitulation of Students' Difficulties in Solving the Problem of Mathematical Connection Ability of Experimental Classes

Indicator	Question Number	Answering Correct		Answer Incorrectly		No Answer	
		Total	%	Total	%	Total	%
Looking for relationships of various representations of concepts, processes, or mathematical procedures	1	23	60.53	14	36.84	1	2.63
Understand the relationship between mathematical topics.	2	19	50	19	50	0	0
Applying mathematics in daily life.	3	19	50	19	50	0	0
Applying mathematics in other fields	4	17	44.74	20	52.63	1	2.63
Understanding representations equivalent to a concept, process, or mathematical procedure	5	15	39.47	20	52.63	3	7.89
Apply a mathematical relation to the issue of a day	6	8	21.05	23	60.53	7	18.42

Based on Table 8 above, it can be seen the number of students who can solve the problem of mathematical connection ability by answering correctly, answering incorrectly, and not answering the experimental class which will be analyzed according to the indicators of mathematical connection ability of questions No. 5 and 6 as follows:

1. The indicator number 5 is to find a relationship between one procedure and another procedure in an equivalent representation. A total of 15 students answered correctly and completely, as many as 20 students answered incorrectly and 3 students did not answer. The results of the analysis of the difficulties of the experimental class on this indicator can be seen in Figure 1.

Figure 1. Student Answers to Problem Number 5 Mathematical Connection Ability Tests

2. The indicator number 6 is the application of mathematical relationships to everyday problems. A total of 9 students answered completely and correctly for the questions given, as many as 23 students gave explanations less correctly, and 7 students did not answer. The results of the analysis of the difficulty of the experimental class on this indicator can be seen in Figure 2.

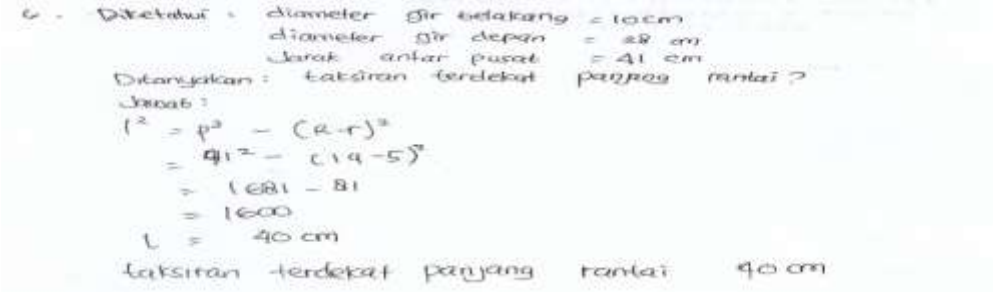


Figure 2. Student Answers to Problem Number 6 Mathematical Connection Ability Tests

Discussion

Learning activities are carried out as many as 10 meetings with different learning (treatment), the experimental class uses the scientific approach and the guided inquiry method and the control class uses the usual learning approach. Learning is done 8 times, 1 meeting to pretest mathematical connection ability, 1 meeting again to postulate mathematical connection ability.

Based on the processing of the data above, it shows that: (1) the achievement and improvement of the mathematical connection ability of junior high school students whose learning uses a scientific approach and guided inquiry method compared to those using the scientific approach only; (2) Difficulties - students' difficulties in solving mathematical connection problems.

The results of processing data show that Ho rejected regarding the achievement and improvement of mathematical connection ability between students in the experimental class and the control class, indicating that the scientific approach and guided inqury significantly influence students' mathematical connection ability. So it can be concluded that the mathematical connection ability of students who get learning with the scientific approach and guided inquiry is significantly better than students who get learning using the scientific approach only.

These results are in line with other researchers who stated that by providing constructive learning will be able to improve students' mathematical abilities (Lindawati, 2011). The research is also in line with other opinions that student activities in the scientific approach are more increasing where in this study emphasizes group discussion by generating activities according to the scientific approach (Ulfa, Mardiyana, & Saputro, 2016).

Based on the observations of researchers in the field shows that: (1) Students play an active role in learning; (2) Improve the ability to work together; (3) Students more quickly understand the contents of the lesson; (4) Can challenge students' abilities and give satisfaction to find new knowledge for students; (5) Can improve student learning activities; (6) Can help students to develop new knowledge and be responsible for the learning they do; (7) This learning is considered to be more fun and liked by students; (8) Can develop students' thinking skills in finding answers / formulas / mathematical concepts.

The implementation of learning steps using the scientific approach and guided inqury can be done well according to the theory. The first stage is orientation, observing and formulating problems. Without good observation and problem formulation, students may not be able to solve the problem correctly. The teacher divides students heterogeneously into groups with the number of members of each group consisting of 4-5 students then the teacher provides Student Worksheets (LKS) which contain a problem that is not routine to students related to circles and tangent circles. Then students observe the problems found in the LKS and write the results of observations related to the problems that have been observed.

The second stage is asking questions and formulating hypotheses. At this stage, students identify problems related to daily life in previous activities and formulate in the form of hypotheses. Then students ask questions about the problems presented in the LKS that are not understood from what is observed to get additional information about what was observed. After students can understand the problem correctly, then students must be able to formulate a hypothesis.

The third stage is collecting information. At this stage, students and group members collect relevant information to answer questions that have been identified through activities to search for and read various references from various sources in order to increase knowledge and understanding of circle material and tangent circles that are being studied. Then students record all information about the material that has been obtained in the textbook and other sources.

The fourth stage is processing information and testing hypotheses. At this stage, students discuss with their group friends to process the information that has been collected from the results of previous activities as well as the results of observing and collecting ongoing information with the help of questions on the student worksheet. Then students verify the results of their observations with data or theory in the source book.

The last stage is communicating and drawing conclusions, students present the results of group discussions in a classic form of conclusions based on the results of the analysis. Other

students respond to the presentations made and other students are given the opportunity to answer them. Then the teacher and the other students pay attention to the work done on the board by their friends and still analyze the completion steps. If students have difficulty in solving problems, the teacher as the facilitator provides direction to students. Students and teachers conclude about important points that arise in learning activities.

Learning using the scientific approach and guided inquiry method can challenge students 'ability to develop students' thinking skills in finding answers / formulas / mathematical concepts. This is one of the advantages of the scientific approach and guided inquiry method which shows that the experimental class is better than the control class.

CONCLUSION

Based on data analysis and discussion, it was concluded that the mathematical connection ability of students learning using the scientific approach and guided inquiry method was significantly better than those using the scientific approach with a 5% significance level and difficulties experienced by students in solving mathematical connection problems. in the experimental class that is located in the indicator applying the relationship of mathematics to everyday problems and looking for the relationship of one procedure to the other procedures in the equivalent representation.

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