The Influence of the Scientific Approach Problem-Based Learning Model to the Ability of Mathematical Communication of Junior High School Students

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ABSTRACT. The purpose of this research is to: (1) obtain the description of mathematical communication ability of Grade VIII students of Junior High School 1 Kendari before being taught by scientific approach of problem-based learning model; (2) obtain a description of mathematical communication ability of Grade VIII students of Junior High School 1 Kendari after being taught by scientific approach of problem-based learning model; (3) know the influence of learning with scientific approach of problem-based learning model to students' mathematical communication ability. This research is experimental research, with population is entire class VIII Junior High School 1 Kendari, while the sample is class VIII-6 as experiment class. The sampling technique used is purposive sampling technique. The result of this research concludes as follows: (1) mathematical communication ability of Grade VIII students of Junior High School 1 Kendari before being taught by scientific approach of problem-based learning model on the right triangle material classified as enough and low where 11 students or 33.33%, students get score between 60 and 79 and 12 students or 36.36%, students got score between 42 and 60; (2) mathematical communication ability of Grade VIII students of Junior High School 1 Kendari after being taught by scientific approach of problem-based learning model on the Pythagoras Theorem material is high where 17 students or 51,52% students get score between 79 and 97; (3) learning with scientific approach of problem-based learning model gives a significant positive influence to students' mathematical communication ability on the material of Pythagoras Theorem, Grade VIII odd semester of Junior High School 1 Kendari academic year 2014/2015.

Keywords: Scientific Approach, Problem-Based Learning and Mathematical Communication Ability.

INTRODUCTION

The ability of mathematical communication is one of the competences of mathematics learning outcomes demanded in the curriculum 2013. The ability of mathematical communication is part of the ability of high-level thinking. In order that high-level thinking ability is able to developed, the learning must be able to place the students to be actively involved in many useful mathematical activities. Students who have weak mathematical communication ability will ensued in the

weakness of other mathematical abilities; otherwise students who have good mathematical communication ability can make a variety of representations.

Baroody in (Wasi'ah, 2004: 1) reveals that mathematical communication is: (1) spoken communication like reading; (2) listening; (3) discussing; (4) explaining; (5) sharing and (6) writing communication or writing through the disclosure of mathematical ideas in real world phenomena through graphs, tables, algebraic equations, or in ordinary language.

In knowing student's mathematical communication ability, hence needed certain indicator. Herdian (2010: 1) reveals that indicators of mathematical communication ability are: (a) can reflect real objects, images, and diagrams into mathematical ideas; (b) model situations or issues using oral, written, concrete, graphic, and algebraic methods; (c) declare everyday events in language and mathematical symbols; (d) listening, discussing, and writing about mathematics; (e) reading with the understanding of a written mathematical presentation; (f) making conjectures, formulating arguments, defining definitions, and generalizations; (g) explaining and making inquiries about mathematics learned.

The ability of students to communicate ideas with symbols, tables, diagrams, graphs, or images is one of the basic abilities of mathematical communication. Mathematics in the scope of communication generally includes skills or ability to write, read, discuss, and discourse. The ability of mathematical communication includes: (1) the ability to rationalize a statement, (2) the ability to change the form of the description into the mathematical model, and (3) the ability to illustrate mathematical ideas in the form of relevant descriptions (Wihatma 2004: 1)

Developing mathematical communication according to NCTM (1989), can provide benefits to students in the form of: (1) modeling the situation with oral, written, drawing, graphic, and algebraically, (2) reflecting and clarifying in thinking about mathematical ideas in various situations , (3) developing an understanding of mathematical ideas including the role of definitions in mathematics, (4) using reading, listening and writing skills to interpret and evaluate mathematical ideas, (5) studying mathematical ideas through conjecture and convincing reasons, (6) understanding the value of the notation and the role of mathematics in the development of mathematical ideas.

The ability of mathematical communication is one part of the ability of high-level thinking in learning mathematics. Therefore, mathematical communication ability should be controlled by the students. The reality on the ground shows that mathematical communication ability in schools is still low. This is also a phenomenon that occurred in Junior High School 1 Kendari. This can be known based on the results of mathematical communication ability tests conducted on August 20, 2014 in Grade VIII of Junior High School 1 Kendari. The results of the test obtained average score of mathematical communication ability as follows: Class VIII-1 is 55,18; Class VIII-2 is 58.90; Class VIII-3 is 54.70; Class VIII-4 is 47.14; Class VIII-5 is 55.30; Class VIII-6 is 25.00; Class VIII-7 is 31.20. The average overall mathematical communication ability for the seven parallel classes is 46.77.

The result of students' mathematical communication ability test written above, identifies the average of mathematical communication ability of Grade VII students in Junior High School 1 Kendari is still very low that is 46.77. Researchers found some weaknesses of students in working

on these questions, especially on issues related to aspects of mathematical communication. The weakness of students in working on problems that require mathematical communication skills are marked by: (1) many students who have not mastered the mathematical concept correctly; (2) the meaning or usefulness of the mathematical symbols contained in the questions is not fully known by the students, so that in doing mathematical problems they often experience a misconception; (3) when a problem is presented in the form of a story, students have difficulty in making a mathematical model of the story; (4) students rarely ask or respond to responses when teachers ask again related to the material that has been studied, this is because students do not know and do not understand what to ask and have not been able to explain mathematical ideas.

Possible causes of poor mathematical communication ability of students, especially on aspects of mathematical communication, such as: (1) the pattern of teaching is still with the stage of giving materials, giving examples and subsequent exercises so that students' knowledge is not the result of the construction of his own thinking; (2) the questions given by teachers are still limited to the concept of materials given; (3) in solving a problem in one question, students are not taught with the various strategies, so if they faced the problems that require high-level understanding, students cannot solve it properly.

Showing the root of the problem that has been mentioned above, it can be concluded that the symptoms are symptoms of students' mathematical communication ability which is still low. So, we need to think about the ways to overcome the problem, namely by applying the appropriate approach and learning model. Permendikbud No. 65 of 2013 (Kemendikbud, 2013) on the Standard Process of Primary and Secondary Education has indicated the need for a learning process guided by the principles of a scientific approach. The effort to apply the scientific approach in this learning process is often referred to as a distinctive feature and a distinct strength of the Curriculum existence of 2013, which is certainly interesting to be studied and elaborated further.

The curriculum of 2013 requires the use of a scientific approach in mathematics learning. Learning with a scientific approach is a learning process designed in such a way that students actively construct concepts, laws or principles through the stages of observing, asking, trying, reasoning / associating and communicating (Kemendikbud, 2013). In connection with this, Suherman (2003: 57) said that essentially the learning of mathematics is to build or construct mathematical knowledge.

In the implementation of learning that uses scientific approach, in it happens a series of processes to achieve learning objectives. This is in accordance with the proposed Hamalik (2001) that learning is not a goal, but learning is a process to achieve goals. This is also in line with Budiningsih (2008) statement that learning in a constructivist view is a process of forming new knowledge that must be done actively by students in doing activities, thinking, conceptualizing, and giving meaning to the things being studied.

One of the learning models that can overcome the problems presented above that is problem-based learning model. Problem-based learning model is learning by confronting students on practical issues as a foothold in learning or in other words students learn through the problems.

Problem-based learning model, aimed to make students can formulate the problem of a mathematical situation, which contains a procedure that is not routine or unstructured properly, then

students can dig information related to the problem, make conjecture and generalize about the concepts and procedures of mathematics (Kadir, 2009). In addition, students are expected to make connections between mathematical ideas by solving problems that are new to them in various ways of completion (Erickson in Kadir, 2009).

In implementing problem-based learning model requires certain steps. Nur and Ibrahim (2007) mentioned that the steps of problem-based learning model are: (a) students' orientation on the problem; (b) organizing students to learn; (c) guiding individual / group experiences; (d) developing and presenting the work; (e) analyzing and evaluating the problem-solving process. The problem-based learning stages that mentioned previously can be integrated with scientific approach activities according to the learning characteristics of the Curriculum 2013 as set out in Permendikbud. 81a Year 2013 (Kemendikbud, 2013).

Based on the above descriptions it is necessary to change the learning paradigm from a teacher-centered teaching view to a student-centered view of learning. Problem-based learning is a learning model that involves students to solve a problem through the stages of a scientific method so that students can learn knowledge related to problems and have the skills to solve problems.

Some research results indicate that the problem-based learning model can improve students' mathematical communication ability, for example: (1) research done by Sucipta (2014), which concludes that the average score of students' mathematical communication ability who taught by scientific approach is higher than the average score of students' mathematical communication ability who taught by conventional learning; (2) research conducted by Hasminah (2012), which concluded that the learning outcomes through mathematical communication ability of students who get problem-based learning model is higher than the result of learning through the mathematical communication ability of students who get conventional learning model.

The purpose of this research are: (1) to obtain the description of mathematical communication ability of Grade VIII students of Junior High School 1 Kendari before being taught by scientific approach of problem-based learning model; (2) to obtain a description of mathematical communication ability of Grade VIII students of Junior High School 1 Kendari after being taught by scientific approach of problem-based learning model; (3) to know the influence of learning with scientific approach of problem-based learning model (PBM) to students' mathematical communication ability.

METHOD

This research was conducted in Junior High School 1 Kendari in the odd semester of academic year 2014/2015. Population in this research is all Grade VIII students at Junior High School 1 Kendari academic year 2014/2015 which spread in seven parallel classes that is class VIII-1 up to class VIII-7. Sampling used is purposive sampling technique which is taking the samples by the consideration of the class that has a low average score of mathematical communication ability. From the sampling technique, then obtained class VIII-6 as a sample used as experimental class which then taught using a scientific approach model of problem-based learning.

Variables in this study there are two kinds, namely the independent variable (X) and the dependent variable (Y). Independent variable is treatment in the form of learning with scientific

approach model of Problem-Based Learning and dependent variable of students' mathematical communication after learning with scientific approach model of Problem-Based Learning.

There are two kinds of instruments in the study, namely the observation sheet and the test of mathematical communication ability. Observation sheets are used to measure the level of activity or participation of teachers and students in the process of learning mathematics by using a scientific approach modeled problem-based learning, while the test of mathematical communication skills used to measure students' mathematical communication skills.

Data collection in this study used observation technique and giving test. Observation technique is used to see teacher activity and students during the learning process, while giving test is used to know students' mathematical communication ability.

In analyzing the data in this study used two kinds of analysis, namely descriptive analysis and inferential analysis. Descriptive analysis is used to describe data about teacher and student activity during the learning process, and to describe data of students' mathematical communication ability that are average, median, mode, maximum value, minimum value, standard deviation and variance. Inferential analysis is used to test the research hypothesis. Before doing the inferential analysis, firstly tested the requirements of analysis, namely normality test and homogeneity test of variance. The data used in the normality, homogeneity and t-test are Normalized Gain (N-gain) scores.

RESEARCH RESULT AND DISCUSSION

Research result

a. Results of Descriptive Analysis of Student Mathematical Communication Skills

The distribution of pretest values of mathematical communication ability of class VIII-6 students of Junior High School 1 Kendari can be seen in Table 1 below:

Table 1. Distribution of Pretest Value of Student Mathematical Communication Ability

Interval	*Category*	f_i	*%*
$97 \leq X \leq 100$	Very high	0	0
$79 \leq X < 97$	high	4	12.12
$60 \leq X < 79$	medium	11	33.33
$42 \leq X < 60$	low	12	36.36
$0 \leq X < 42$	Very low	6	18.18

Table 1 above shows that students who have a level of mathematical communication ability before treatment are very low, namely 6 students or 18.18%; Low category as many as 12 students or 36.36%; medium category as many as 11 students or 33.33%; High category as many as 4 students or 12.12% and no students who have very high level category of communication mathematical ability.

The distribution of posttest grades of class VIII-6 Junior High School 1 Kendari after treatment which applied scientific approach of problem-based learning model on Pythagoras Theorem material. The distribution of values can be seen in Table 2 below.

Table 2. Posttest Value Distribution of Students' Mathematical Communication Ability after Treatment

Interval	*Kategori*	f_i	*%*
$97 \leq X \leq 100$	Very high	3	9.09
$79 \leq X < 97$	High	17	51.52
$60 \leq X < 79$	Medium	12	36.36
$42 \leq X < 60$	Low	1	3.03
$0 \leq X < 42$	Very Low	0	0

Based on Table 2 above shows that after given treatment in the form of learning with scientific approach model of problem-based learning obtained data as follows: no students who have very low category, students who have low level of mathematical communication ability as much as 1 student or 3.03%; medium category as many as 12 students or 36.36%; High category as many as 17 students or 51.52%; Very high category as many as 3 students or 9.09%

The distribution of the score of N-gain class VIII-6 Junior High School 1 Kendari is the distribution of the improvement of mathematical communication ability experienced by the students after the treatment in the form of learning by using the scientific approach of problem-based learning model, the result as in Table 3 below:

Table 3. Class N-Gain Data Distribution VIII6

N-gain	f_i	*%*
High	13	39.39
Medium	12	36.36
Low	8	24.24

Table 3 above shows that after doing treatment in the form of learning using scientific approach of problem-based learning model is classically obtained by the improvement of students' mathematical communication ability in low category as many as 8 students or equal to 24.24%, medium category as many as 12 students or equal to 36.36%, high category as much 13 students or 39.39%.

Furthermore the distribution of N-Gain of students' communication ability is as in Table 4 below:

Table 4. N-Gain Distribution of Student Communication Skills

Statistics

N_Gain

N	Valid	33
	Missing	33
Mean		.5306
Std. Error of Mean		.05965
Median		.6000
Mode		.60[a]
Std. Deviation		.34265
Variance		.117
Skewness		-.808
Std. Error of Skewness		.409
Kurtosis		.033
Std. Error of Kurtosis		.798
Range		1.25
Minimum		-.25
Maximum		1.00
Sum		17.51

Based on Table 4 above, the results of descriptive analysis using IBM SPSS Statistics 21 found that the mean value of N-Gain was 0.531, the median is 0.60, the mode is 0.60, the standard deviation is 0.34, and the variance is 0.12.

b. Results of Inferential Analysis of Student Mathematical Communication Skills

After analyzing the analysis requirements, it is known that pretest and posttest data are normal and homogeneous distributions. Hypothesis test is done, that is by using paired t-test, the result as in Table 5 below:

Table 5. Results of Inferential Analysis of N-Gain Data

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pre_Test - Post_Test	-23.30	17.13577	2.98295	-29.372	-17.21937	-7.810	32	.000

Hypothesis test results in Table 5 above shows that there is an increase in the ability of mathematical communication from pretest to posttest. This is indicated by the value of t.count = 7.810 > t.table = 2.037 or ρ value = 0.000 < 0.05, then H_0 rejected or H_1 received. Thus it can be

concluded that there is a significant influence of learning by scientific approach problem-based learning model to mathematical communication ability of Grade VIII students of Junior High School 1 Kendari on the Pythagoras Theorem material.

Discussion

Based on the study of the implementation and learning outcomes of mathematics at Junior High School 1 Kendari, one of the causes of difficulty in developing mathematical communication ability in mathematics subjects is when students are faced with a mathematical problem, most of students just memorize the concept so that students have not been able to identify information which is found in a mathematical problem. As a result, when faced with a mathematical problem that requires understanding, the student has difficulty. Therefore, attention is needed in the process of learning mathematics, especially related to the approach and the learning model used. One approach and a learning model that emphasizes students actively involved is a scientific approach with a problem-based learning model. This is in accordance with the characteristics of learning in the Curriculum of 2013 as printed in Permendikbud. 81a Year 2013 (Kemendikbud, 2013).

Based on data analysis of research results, the following are presented some findings in connection with the improvement of students' mathematical communication ability.

1. Description of Learning Implementation

During the research process took place, the researchers used class VIII-6 as a sample of research, i.e. classes that were taught using a scientific approach modeled problem-based learning. The total of meetings in this study is eight meetings with six meetings used for the learning process and two meetings used for the implementation of pretest and posttest of students' mathematical communication ability.

This research uses LKS in order to help students find mathematical concepts, because the problems presented in the LKS are designed so that students are able to find mathematical concepts from the material learned based on their own experience, but in the implementation of learning with LKS, there are some students who are able Solve problems in the LKS until they find concepts and there are also students who have not been able to give a conclusion of the problem solved caused by the limited time of instruction set. In addition, the initial concept that students have about the Pythagoras Theorem subject is still very lack.

Implementation of learning at the first meeting experienced little resistance. Students take time to adjust to the newly applied learning model in the classroom, especially at the time of group formation. Several students exhibit less cooperative attitudes in groups, so few students are active in group study during the learning process. This resulted in the absorption of learning materials by students less than the maximum. Slowly, the obstacles that occur can be overcome and minimized. Teachers can control and direct students very well, so students enthusiastically work together in groups.

Implementation of learning at the second meeting and subsequent meetings, the learning process can run well and smoothly, although at the second to fourth meeting, some students still have difficulty in digging and processing information from LKS and other learning resources, so

that students have not been able to solve the problem by themselves, but with the direction and guidance from the teacher. The students have started to understand the problem-based learning model, so that in the next meetings, teachers and students have shown an enthusiastic attitude in the learning process. Students also begin to feel responsible in their group study to do group tasks. In addition, teachers are able to provide feedback on student responses and encourage students to gather information to find solutions to problems. So it can be concluded that, students also need time to adapt to a new learning applied.

2. Mathematical Communication Ability of Students before and after being Taught by the Scientific Approach Problem-Based Learning Model

Data of students 'mathematical communication ability is obtained through students' mathematical communication ability test. Before the students are taught with the scientific approach of problem-based learning model, the test given related to one of the prerequisite materials of Pythagoras Theorem is the right triangle material and test given after the treatment that is test on Pythagoras Theorem material.

Based on the results of descriptive analysis of the data obtained through the students' mathematical communication ability test, the pretest obtained the average value lower than the average value obtained on posttest. Based on the average score, the students' mathematical communication ability before the treatment is in the low category whereas after treatment the students' mathematical communication ability as a whole is in the high category. This indicates that from the mean indicator, the learning with the Scientific Approach Problem-Based learning model can give a good influence in improving students' mathematical communication ability. From the data diversity indicator the pretest has greater variance than the posttest data variance. The value of data diversity from both data indicates that students' mathematical communication ability before learning is more diverse than after learning. Median, the mode of pretest results is lower than that of the posttest. The mode of the two test results illustrates that students 'mathematical communication ability before treatment are mostly in the low category, whereas after treatment most of the students have high students' mathematical communication ability. Improvement of students' mathematical communication ability after problem-based learning is also demonstrated by the mean score of N-Gain, as a whole the students have improvement.

Distribution of pretest and posttest data in this study can give a tentative conclusion that learning with scientific approach of problem-based learning model can give a significant positive effect that is in the form of improvement to students' mathematical communication ability.

Hypothesis testing in this study using t-test paired data (Paired Sample t-test). Based on the results of hypothesis testing using t-test paired data obtained t.count value = 7.810 > t.table = 2.037 so H_0 rejected or H_1 accepted and thus it can be concluded that there is a significant influence of scientific approach model of problem-based learning model to the mathematical communication ability of Grade VIII students of Junior High School 1 Kendari on the material of the Pythagorean Theorem.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the results of the analysis and discussion, it can be concluded as follows: (1) mathematical communication ability of Grade VIII students of Junior High School 1 Kendari before using the scientific approach of problem-based learning model on the right triangle material classified as enough and low where 11 students or 33.33% students score between 60 and 79 and 12 students or 36.36%, students get score between 42 and 60; (2) mathematical communication ability of Grade VIII students of Junior High School 1 Kendari after learning using scientific approach of problem-based learning model on Pythagoras Theorem material is high where 17 students or 51.52% students get score between 79 and 97; (3) learning using scientific approach of problem-based learning model gives a significant positive effect to students' mathematical communication ability on the material of Pythagoras Theorem, Grade VIII students of Junior High School 1 Kendari academic year 2014/2015.

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