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The mathematical communication ability based on student's self-confidence in Problem Based Learning models with brainstorming techniques

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Abstract

The mathematical communication ability is an important aspect that every student must have. The Facts show that mathematical communication ability and student confidence are still not optimal. One effort to overcome that is by applying PBL models with brainstorming techniques. The purpose of this study was to test the effectiveness of the PBL model with brainstorming techniques on students' mathematical communication ability, describing mathematical communication ability on PBL models with brainstorming techniques in terms of student confidence. This research uses mix method approach with a concurrent embededded model. The population of this study was class VIII of SMP Negeri 1 Ungaran in the 2018/2019 school year. The results showed that: PBL models with effective brainstorming techniques for learning as indicated by learning outcomes in aspects of mathematical communication ability achieve mastery learning individually and classically as well as the average learning outcomes in classes using PBL models with brainstorming techniques more than average learning outcomes in the classroom using the PBL model, subjects with high self-esteem can meet all indicators of mathematical communication ability, on subjects with moderate self-confidence only able to meet indicators explaining ideas, situation and mathematical relationship at writing and indicators listening, discussing and writing about mathematics. Whereas for subjects with low levels of self confidence have not been able to meet all indicators of students' mathematical communication ability.

1. Introduction

The objectives of mathematics subjects in the 2013 curriculum are covered in a copy of Attachment III of Permendikbud number 58 of 2014, which includes communicating ideas, reasoning, and being able to compile mathematical evidence using complete sentences, symbols, tables, diagrams or other media to clarify the situation or problem. The purpose of this mathematics subject is in accordance with NCTM (2000) which formulates five mathematical abilities which students must have. The five mathematical abilities include problem solving ability, communication ability, reasoning and proving ability, connection ability and representation ability. Basically, communication skills and mathematical logical thinking and learning independence (self regulated learning), are essential affective abilities and behaviors that students need to have and develop in learning mathematics.

According to Nurlia (2015), with mathematical communication ability, a person can utilize mathematics to solve problems in daily life both for oneself and for others. With mathematical communication ability, students can illustrate and interpret various problems in language and mathematical statements and can solve these problems according to mathematical rules or methods. Based on this it is necessary to submit mathematics in logical and systematic language so that the listener can receive information well. This is in accordance with the opinion of Arifin (2014) which states that mathematical language that is logical and systematic prevents ambiguity in interpreting the information conveyed, either in the form of concepts or definitions.

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One of the junior high schools in Semarang, especially in Semarang district is SMP Negeri 1 Ungaran. Based on the data processing report of the National Junior High School National Examination by the Ministry of Education and Culture in 2016/2017 school year, it is known that the average mastery of mathematical questions for the ability to understand the concept of coordinate is still low at 50.02 even though this material is very important because it is often related to problems in daily life -day. Many students still have difficulty communicating their mathematical ideas.

According to Rohaeti's research as quoted by Fachrurazi (2011), the average mathematical communication ability of students are in poor qualifications. This is supported by Purniati's research as quoted by Fachrurazi (2011) which states that students' responses to mathematical communication problems are generally still lacking. In fact, most students who are mathematically savvy cannot convey their mathematical thoughts and ideas, as if they do not want to share their knowledge with others. This is also in accordance with the results obtained when observing and conducting interviews with Ms. Retno as a mathematics teacher at SMP Negeri 1 Ungaran on February 12, 2018. Based on the interview results it is known that students still have difficulty in conveying ideas or ideas in their minds to solve problems mathematics given by the teacher both in writing and verbally. For example in written form, students still have difficulty in understanding a problem given by the teacher so that students find it difficult to express ideas in mathematical language.

In addition to the results of an interview from Ms. Retno as a Mathematics teacher at SMP Negeri 1 Ungaran, on Saturday April 28, 2018 a preliminary study was also conducted by giving questions to 35 students of class VIII C of SMP Negeri 1 Ungaran by testing three indicators of mathematical communication ability, namely (1) stating everyday events in language and mathematical symbols (2) Ability to explain ideas, situations and mathematical relations in writing (3) Ability to make conjectures, construct arguments, formulate definitions and make generalizations. Based on the results of the preliminary study, it was found that students who had achieved indicator (1) had 31 students. There are 11 students who reach indicator (2) and students who reach indicator (3) there are 3 students. Based on this, it can be concluded that mathematical communication ability are still lacking so it needs to be studied. The following are the results of the work of one of the students in the preliminary question.

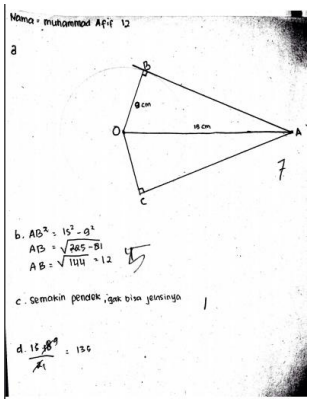

Figure 1. Examples of Student Work Preliminary Questions

Mathematical communication requires a sense of confidence to get ideas and then write them down. According to psychologist Sigmund Freud as quoted by Melisa (2015) that self-confidence is a level of certain suggestions that develop in a person so that they feel confident in doing something. Beliefs and positive judgments will make someone motivated to learn so as to obtain satisfying achievements. In the book Self-Concept in Education (1988) as quoted by Ameliah, et al (2016) said that, from various observations made it turns out that many students experience failures in lessons not caused by a low level of intelligence or weak physical condition, but by the feeling of being unable to do the task.

Other information obtained after conducting an interview on Tuesday, February 12, 2018 to Ms. Retno as a mathematics teacher in class VIII of Ungaran State Junior High School is that students do not have good self-confidence ability. This was proven during the learning process, students were still unsure of the answers to the questions they had worked on. Some students still ask questions to other friends. Especially when working in front of the class and explaining to his friends. This lack of confidence results in students often giving up before trying to work on math problems that they find difficult so that it will hinder the development of students' mathematical communication ability.

The students' mathematical communication ability is not yet optimal, it cannot be separated from the learning process in SMP Negeri 1 Ungaran. The learning used in SMP Negeri 1 Ungaran already uses the Problem Based Learning learning model, but there are still weaknesses of students related to mathematical communication ability. In addition, students are also not accustomed to discussing, asking questions, responding to, or expressing opinions, causing students to develop mathematical communication not developing.

According to Puspitasari as quoted by Fathiya (2014) states that the selection of learning models affects the activities of students in the classroom. Therefore, suitable models and strategies are needed to overcome these problems. One alternative is the Problem Based Learning model. The Problem Based Learning Model is a student-centered learning model that encourages students to compile their own knowledge, develop critical thinking skills, find and solve problems independently. According to Selcuk (2010) quoted by Hastuti (2014) states that PBL is a learning model that encourages students to be active and increase self-confidence during learning. According to Hastuti (2014) on research in SMP 22 Surakarta stated that the application of the Problem Based Learning model can improve students' mathematical communication ability and can be used as an alternative to improve mathematical communication of junior high school students. In addition, according to Fathiya (2014) states that PBL learning models provide space for students to be able to find and build their own concepts and can develop students' thinking skills. That means the PBL learning model can encourage students to be active and confident in learning. In an effort to improve students' abilities in aspects of mathematical communication, brainstorming methods can be used.

According to Wulandari (2010) states that the brainstorming method is a combination of the question and answer method and the discussion method. Brainstorming is appropriate as an effort to collect opinions expressed by each group member either individually or in groups by not cornering or blaming individual opinions so that students will not be afraid to express their opinions.

Based on the description shows that the Problem Based Learning model with Brainstorming techniques can be used as an alternative learning. Therefore, researchers are interested in wanting to conduct research on mathematical communication ability in terms of student confidence in the Problem Based Learning model with brainstorming techniques in class VIII students.

Based on the description above the problem was formulated as follows, (1) did the mathematical communication ability of students of class VIII of SMP Negeri 1 Ungaran in the Problem Based Learning model with Brainstorming techniques reach minimal completeness criteria ?; (2) whether the mathematical communication ability of students of class VIII of SMP Negeri 1 Ungaran on the Problem Based Learning learning model with brainstorming techniques achieve classical completeness ?; (3) is the mathematical communication ability of students of class VIII of SMP Negeri 1 Ungaran using PBL learning with brainstorming techniques better than the mathematical communication ability of students of class VIII at SMP Negeri 1 Ungaran using PBL learning ?; (4) is the proportion of mathematical communication completeness of class VIII students of SMP Negeri 1 Ungaran using PBL learning with brainstorming techniques better than the proportion of mathematical communication completeness of class VIII students of SMP Negeri 1 Ungaran using PBL learning ?; (5) how is the description of mathematical communication ability in terms of students' confidence using the PBL learning model with brainstorming techniques in class VIII students of SMP Negeri 1 Ungaran?

2. Methods

This study uses a concurrent embededded model research method. The method is a method that combines qualitative research methods and quantitative research methods by mixing the two methods unbalanced.

The population in this study was grade VIII of SMP Negeri 1 Ungaran in the 2017/2018 school year. The sampling technique used in the selection of quantitative subjects is the cluster random sampling technique, which is chosen at random several classes desired from the population. In this study, two sample classes were taken, namely the experimental class and the control class. The experimental class is a class that is given a learning treatment using PBL with brainstorming techniques, namely class VIII C and the control class is a class that is treated using a PBL model, namely class VIII D.

The selection of qualitative subjects was selected by purposive sampling technique. According to Sugiyono (2013) states that purposive sampling is a sampling technique with certain considerations that is taken the most expert in the ability under study. In this case, students were given the instruments of classifying students' confidence with low, medium and high levels which were then selected by 6 students as interview subjects, namely 2 students with high confidence classification, 2 students with moderate

confidence classification and 2 students with classification of confidence low. Classifying students into the category of confidence is based on student answers by means of a self-assessment questionnaire using the Likert scale provisions.

The instruments used in this study were test instruments, questionnaire instruments and interview guidance instruments. Test instruments in the form of questions to measure students' mathematical communication ability. While the confidence questionnaire instrument to enable the classification of self-confidence. The interview guide instrument is used as a guide for conducting interviews with research subjects.

The data collection techniques used in this study are as follows, (1) test, before the test is given, it is first tested on a trial class to find out the level of difficulty, differentiation, validity and reliability of test items. Written test is carried out after students get the coordinate system material in the PBL model with brainstorming techniques for the experimental class and in the PBL model for the control class, (2) questionnaire, in this study the questionnaire is used to obtain data related to the classification of student confidence, (3) interviews , in this study the type of interview used is unstructured interviews, this interview was conducted to determine the description of mathematical communication ability in terms of student confidence after receiving learning in the PBL model with brainstorming techniques.

3. Results & Discussions

The study was conducted on August 24 until September 14, 2018 in SMP Negeri 1 Ungaran which is located at Jalan Diponegoro No. 197, Sidomulyo, Ungaran Barat, Central Java 50511. Following are the results of an analysis of mathematical communication ability tests.

Table 1. Summary of Analysis Results of Mathematical Communication Ability Tests

No	Descriptive statistics	Test Results	
		Experimentation Class	Control class
1	Maximum Score	96	97
2	Minimum Score	58	56
3	Average	86,387	78,61

The confidence used in this study uses indicators of confidence according to Lauster's Theory. Based on the filling of self-confidence questionnaire from 31 students of class VIII C of SMP Negeri 1 Ungaran, the results of the classification of confidence levels were obtained.

Table 2. Confidence Classification Results

No.	Group	Number of students
1	High	6
2	Moderate	23
3	Low	2

Based on the classification of the confidence level, 6 students were chosen who later became the subject of the interview. The interview subjects chosen to analyze their communication skills can be seen in table 3.

Table 3. Interview Subject

No.	Code	Level of Confidence
1	KE-10	High
2	KE-28	High

3	KE-20	Moderate
4	KE-26	Moderate
5	KE-8	Low
6	KE-21	Low

In this study normality tests were performed on the mathematical communication ability test data of the experimental class and the control class used to determine whether the data came from populations that were normally distributed or not. Based on the analysis using SPSS 16.0 software, the value of $sig = 0.298$ is obtained, this value is more than 0.05. So it can be interpreted that the results of tests of mathematical communication ability come from populations that are normally distributed.

Homogeneity test in this study aims to determine whether the two sample classes have the same variance or not. Based on calculations using SPSS 16.0 software through the Test of Homogenity of Variances, sig = 0.883, this value is more than 0.05. So, it can be concluded that the results of mathematical communication ability tests in this study come from classes that have the same or homogeneous variance.

Furthermore, to find out the learning outcomes of students on mathematical communication ability individually individual class students who use the PBL model with brainstorming techniques reach minimal completeness criteria or no t test is performed. Based on calculations obtained $t_{count} = 3.804$, while the value of $t_{table} = 1.697$. This shows the value of t_{count} more than t_{tabel}. So, the mathematical communication ability of Grade VIII students in the Coordinating System material in PBL learning with brainstorming techniques achieve completeness.

Then a test is performed to determine whether mathematical communication ability using the PBL model with brainstorming techniques achieve mastery learning. Learning reaches mastery learning if the results of tests of mathematical communication ability exceed the classical completeness requirement of 75% which reaches the specified minimal completeness criteria that is 80. Based on the calculations obtained $z = 0.725$, while the value of $-z_{table} = -1.64$. This shows the z value is more than $-z_{table}$. So, the mathematical communication ability of the eighth grade students of the Coordinate System material in PBL learning with brainstoming techniques achieve classical learning completeness.

The average two similarity test (one-party test) is used to determine whether students' mathematical communication ability through the PBL model with brainstorming techniques are better than mathematical communication ability using the PBL model. Based on the calculation results obtained $t = 3.199$, while the value of $t_{table} = 1.671$. This shows the value of t is more than the value of t_{table}. This means that the average test results of students 'mathematical communication ability in classes using PBL learning with brainstorming techniques is more than the average test of students' mathematical communication abilities in classes using PBL learning.

Furthermore, a similarity test of two proportions was carried out (one-party test). This hypothesis test was conducted to find out the proportion of students who had finished learning in class using PBL learning with brainstorming techniques more than the proportion of students who had finished learning in class using PBL models. Based on the calculation results, obtained $z = 1{,}923$, while $z_{table} = 1.64$. This shows the value of z is more than the value of z_{table}. This means that the proportion of students who have finished learning in class using PBL learning with brainstorming techniques is more than the proportion of students who have finished learning in class using PBL models.

3.1 Quantitative Discussion

In this study, the data obtained showed that from 31 students who took the mathematical communication ability test in the class using the PBL model with brainstorming techniques there were 25 students who reached minimal completeness criteria 80. This was reinforced by the analysis of mathematical communication ability test data with the acquisition of grades $t_{count} = 3.804$ and $t_{table} = 1.697$. Because $t_{count} > t_{table}$, H_0 is rejected. So the average mathematical communication ability in the class using PBL models with brainstorming techniques reach minimal completeness criteria 80.

Based on the data obtained also shows that the proportion of students who completed the minimal completeness criteria is 80.6%. This means that the proportion of students who complete the class using the PBL model with brainstorming techniques is more than 75%. This is reinforced by the analysis of mathematical communication ability test data with the acquisition of $z_{count} = 0.725$ and $z_{table} = -1.64$. Because $z_{count} > z_{table}$, H_0 is accepted. So the mathematical communication ability of students

using the PBL model with brainstorming techniques achieve classical completeness, which is more than 75%.

In the description above, students who use the PBL model with brainstorming techniques that are complete in minimal completeness criteria are 25 students and the percentage of students who completed classically is 80.6%. This shows the percentage of students who achieve mastery learning in class using PBL learning with brainstorming techniques more than 75% of all students in the class.

The average mathematical communication ability of students in the PBL model with brainstorming techniques is more than the average mathematical communication ability of students using the PBL model. This can be seen from the acquisition of the value of $t_{count} = 3.119$ and $t_{table} = 1.671$. Because $t_{count} > t_{table}$, H_0 is rejected. So the average mathematical communication ability test in a class that uses PBL learning with brainstorming techniques is better than the average mathematical communication ability test in a class that uses the PBL model.

The proportion of students who have finished learning in class using PBL models with brainstorming techniques is more than the proportion of students who have finished learning in class using PBL learning models, namely from the calculation of the value of $z_{count} = 1.923$ and $z_{table} = 1.64$. Because $z_{count} > z_{table}$, H_0 is rejected. So the proportion of students who have finished learning in class using the PBL model with brainstorming techniques is more than the proportion of students who have finished learning in class using PBL learning models.

One of the results of this research is that learning using learning using PBL learning with brainstorming techniques can improve students' mathematical abilities. According to Selcuk as quoted by Hastuti (2014) which states that the application of the PBL model can improve students' mathematical communication ability. It is also in accordance with the opinion of Al-khatib (2012) explaining that the purpose of brainstorming as a teaching strategy is to encourage and improve communication skills, help in promoting thinking and decision-making skills and to produce different opinions and perspectives. In addition, this opinion is reinforced by Roestiyah (2008) who explains that the purpose of brainstorming is to deplete whatever students think about in responding to problems raised by the teacher in the class. Using this technique, students are encouraged to think and express their opinions about the problem at hand. Based on this, brainstorming techniques can train students in improving students' mathematical communication ability and can make classically complete learning outcomes 75%.

3.2 Qualitative Discussion

In this study, it was found that the average value of the mathematical communication ability test for students with high, medium and low levels of self confidence were 89.7; 87.2; and 66.5. Based on this, it can be said that students with high levels of self-confidence have an average mathematical communication ability test higher than students with medium and low levels of self-confidence.

Based on the analysis of the results of the study, it was found that students with low levels of confidence did not meet the first mathematical communication indicator, namely explaining ideas, situations and mathematical relationships in writing, whereas students with moderate and high levels of confidence could meet these indicators. Seen from the work of students with moderate and high levels of confidence where they can express the ideas they have gotten into written form correctly and appropriately. This is supported by the opinion of Alfitri (2016) which states that a person can be said to have self-confidence if he has confidence in his ability to overcome problems so that in dealing with problems students can express mathematical ideas through oral and written, describe mathematical ideas in visual form, and use mathematical notation and terms to present mathematical ideas well. This opinion is reinforced by Tandiling (2012), learning with self-confidence owned can be used to think so that students dare to express ideas. Students with low levels of confidence are less able to meet the third mathematical communication indicator that is listening, discussing, and writing about mathematics. While students who have a high level of confidence and are meeting these indicators. This assumption is supported by the opinion of Selcuk (2010) cited by Hastuti (2014) which states that PBL is a learning model that encourages students to be active and increase their confidence during learning. This is reinforced by research conducted by Widyaningrum (2015) which concluded that subjects who have moderate or high confidence can express their opinions in class discussions. In the second mathematical communication indicator which states daily events into mathematical language and symbols, students with low and moderate levels of confidence are unable to meet these indicators, while students who have high levels of confidence are able to meet these indicators. This is supported by research from Alfitri (2016) that a person can be said to have confidence if he has confidence in his abilities in overcoming problems so that in dealing with problems students can express mathematical ideas through oral and

written, describing mathematical ideas in the form visual, and use mathematical notation and terms to present mathematical ideas well.

Based on the description above it is found that students with high levels of confidence are able to meet all indicators of mathematical communication ability. Students with moderate levels of self confidence are only able to meet indicators explaining ideas, situations and mathematical relationships in writing and indicators listening, discussing and writing about mathematics. Whereas students with low levels of self-confidence have not been able to fulfill all indicators of students' mathematical communication ability. In addition, during interviews students with high levels of confidence are more confident in conveying the answers that have been obtained. In students with moderate confidence there is still doubt in conveying their answers. Whereas students with low levels of confidence several times did not answer the interview questions asked. This is because participants with high confidence have confidence in themselves in dealing with all phenomena that occur, have a good assessment from within themselves, both from the views and actions taken, and students who have a high level of confidence are also able to express something in him who wants to be revealed to others without coercion or something that hinders. Students with high confidence have an average mathematical communication ability that is higher when compared to students who have moderate or low confidence. This is supported by research from Jahani and Behzadi (2014) which concluded that there is a strong relationship between confidence and mathematical ability. so that the higher one's confidence, the mathematical ability of students will also increase.

4. Conclusion

Based on the results of research and discussion obtained conclusions about mathematical communication ability in terms of student confidence in the problem based learning model with class VIII brainstorming techniques on the coordinate system material. These conclusions can be described as follows, (1) mathematical communication ability of students of class VIII of SMP Negeri 1 Ungaran on the problem based learning model with brainstorming techniques reaching minimal completeness criteria; (2) mathematical communication ability of eighth grade students of SMP Negeri 1 Ungaran on the problem based learning model of learning using brainstorming techniques to achieve classical completeness; (3) mathematical communication ability of students of class VIII of SMP Negeri 1 Ungaran using PBL learning with brainstoring techniques better than mathematical communication ability of students of class VIII of SMP Negeri 1 Ungaran using PBL learning; (4) the proportion of mathematical communication mastery of grade VIII students of SMP Negeri 1 Ungaran using PBL learning with brainstorming techniques is better than the proportion of mathematical communication completeness of class VIII students of SMP Negeri 1 Ungaran using PBL learning; (5) based on the analysis of students' mathematical communication ability in PBL learning with brainstorming techniques in terms of self confidence obtained the following results, (a) students with high confidence are able to meet all indicators of mathematical communication ability; (b) students with moderate self confidence are only able to meet indicators explaining ideas, situations and mathematical relationships in writing and indicators listening, discussing and writing about mathematics; (c) students with low self-confidence have not been able to meet all the indicators of students' mathematical communication ability.

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