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Mathematical communication ability with brain-based learning model in terms of gender

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Abstract

Mathematical communication ability is one of the basic skills standards in mathematics. However, mathematical communication ability with students is still low. This can be seen from the work of students who still have difficulty expressing mathematical problems with mathematical symbols and have difficulty interpreting mathematical ideas in writing. It seems that students find it difficult to express mathematical ideas into writing. This study aims to (1) determine the attainment of the classic dimension of the ability of mathematics students to communicate through the Brain-Based Learning model (2) compared the ability of mathematics based on gender through the Brain-Based Learning model (3) to describe the ability of mathematics students to communicate through gender. This study uses a mix method with a sequential Explanatory. The population is the eighth grade high school student of State 31 at the same time. The sample in this study is a class VIII B student determined by random sampling techniques. The subject of this study was taken on the basis of the student gender. There are six students, three male students and three female students. The results of this study show that: (1) the ability of students to communicate mathematically in Pythagorean matter through the Brain-Based Learning model reaches the classical dimension (2) there is no significant difference in the ability of students to communicate mathematically between men and women through the Brain-Based Learning model (3) Women are better at explaining the idea of the situation and the mathematical relationship in writing with real things, images, graphics, and algebra, and also women are better at creating concepts, formulating arguments, and generalization than men. But in terms of connecting real things, images, and diagrams to the idea of mathematics and also in terms of expressing everyday events in language or the symbol of mathematics between students and girls there is no significant difference.

1. Introduction

Mathematics is a very important subject. Mathematics is needed in every element of our daily life, for example; counting the number of items, collecting, processing, and presenting data, and many more uses of mathematics in everyday life. In addition, mathematics is also useful to help understand other fields of study such as physics, chemistry, pharmacy, architecture, and so on so that students are able to think logically, practically, and critically. Mathematics is so important that it becomes the main subject that we learn from elementary school to high school. In every element of life we use mathematics. However, Indonesian students still lack mastery of mathematics. This can be seen from the results of the PISA (Program for International Students Assessment). The triennial survey conducted by the OECD which was participated by 79 countries aims to measure reading, math and science skills. The PISA survey was followed by 15 year olds. PISA results in 2018 Indonesia ranks 73 out of a total of 79 countries on the math test. These results indicate that Indonesia is still weak in understanding mathematics.

Mathematics is science that requires good instincts, so that students can express ideas in the form of symbols or mathematical waves clearly and accurately. Sukoco, H & A. Mahmudi (2016) reveals that learning mathematics is not only about complexity and computation but is more pressing on how students can contract ideas and use logic well. In NCTM (2000: 268), in mathematics, the educated participants

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are also charged with thinking and learning about mathematics and can express their thoughts in both language and writing. The ability to communicate mathematical ideas to other people either literally or written called the ability to communicate mathematically. The mathematical ideas can be complex, conceptual, or problem-solving strategies. The mathematical idea is translated using the ability to communicate mathematically into the mathematical model. The mathematical model can be notation, graph or equation.

NCTM (2000) mentions some basic skills standards in mathematics, namely (1) problem solving; (2) explanation and evidence; (3) mathematical communication; (4) mathematics connection; dan (5) representation. It shows that the ability to communicate mathematically is one of the important abilities that students have to have to learn mathematics. Anintya et al. (2017) also revealed that weak mathematical communication skills will result in a lack of other mathematical capabilities.

Baroody (1993) and Umar (2012) mentioned five aspects of communication: representing, listening, reading, discussing, and writing. It's important for a teacher to know the mathematical abilities of his students. The enhanced participant's mathematical communication capabilities can reflect the mathematical understanding and lay out the concept errors acquired by the enhanced participant (NCTM 2000: 272). If there is a concept error accepted by the educated participant, then the purpose of the study cannot be achieved well. That's why the ability to communicate mathematically is very important to the educated participants. Umar (2012) says it is important to focus communication in mathematics learning; First, because mathematics is basically a second language and second because learning mathematics is the same thing as doing social activity.

Government Rule No. 22 of 2016 on Standar Isi, explains the importance of mathematical communication. One of the aims of studying mathematics at school is to enable educated participants to communicate ideas with symbols, tables, diagrams, or other media to clarify problems and situations.

In order to improve the ability of students to communicate mathematically, teachers need to do the right strategy. One of the strategies is to apply the Brain-Based Learning model. According to Jensen (2008: 5) Brain-Based Learning is a lesson adapted to how brain work with a scientific design that drives students to learn. According to the Goddess (2013), Brain-Based Learning is learning based on the structure and way the brain works so that the brain works better. Saleh (2012: 28) also reveals whether a brain-matching learning can be assured that students are easy to understand the subject matter and remain focused and active during the learning process. With the Brain-Based Learning model, students can find ideas to develop their mathematical communication. This is supported by the Duman statement (2006: 23) if Brain-Based Learning not only improves academic performance but can also provide good motivation for students and teachers with a conducive class mood, joint ventures, and interest. Sukoco, H & A. Mahmudi (2016) in his study showed that the ability to communicate mathematically students is better when using the Brain-Based Learning model compared to those who follow the conventional course.

Studying mathematics has many factors to look at, such as skills, certain intelligence, teacher and student preparedness, and teaching methods. But of many of those factors, it turns out that gender differences also affect. It is predicted that there are physiological and psychological differences in the learning process. Gender differences not only affect mathematical skills, but also how to acquire mathematical knowledge (Susento, 2006). Generally, the ability to communicate between different men and women. There are many factors that affect that. Some studies show that there are physical differences between the male and female brains in structure and physiology (Triadi, 2013).

Based on the above analysis, to find out the mathematical communication of the male and female students of secondary school 31, while using the Brain-Based Learning model, researchers conducted research titled “Mathematical Communication Ability with Brain-Based Learning Model in Terms of Gender”.

2. Methods

The research method carried out by the researcher is mixed methods or mixed research methods. The research design used in this study is a sequential Explanatory using data and qualitative results to help translate the meaning of data and quantitative research results (Cresswell & Clark, 2013). The population in 8th grade Junior high school 31 Semarang all year of the 2017/2018 study year, which is the classes VIII A to VIII H. The sample to be used in this study is the class VIII B of 36 students. Quantitative

Method used to determine (1) the ability of mathematics students to communicate in Pythagorean matter through the Brain Based-Learning model has reached the classic dimension (2) the difference of the ability of mathematics students to communicate with girls through the Brain-Based Learning model. Quantitative data analysis using test using Proportion Test π(one side) and t test.

The subject of this study was taken on the basis of the gender of VIII B Junior high school 31 Semarang students. There are six students, three male and three female students, to be a source of qualitative information about mathematical communication skills. The variables used in this study are free variables and control variables. The free variable is the learning model Brain-Based Learning. While the control variable is the gender difference between in 8th grade Junior high school 31 Semarang students.

Research was conducted in Junior high school 31 Semarang, province of Central Java. The subjects of this study are 6 students of 8th grade. The selection of subjects in this study using purposeful sampling techniques. Sugiono (2016: 124) said that purposeful sampling is a sampling technique with certain considerations. A factor that affects the researcher to select the six students on the basis of advice from the teacher of forgiveness and also the timing for carrying out the research.

The data collection method used in this research is testing and interviewing. The test method used to determine the position of students in the classroom and to figure out a picture of the ability of mathematical communication based on the gender difference of students with the Brain-Based Learning model. The test in this study is a mathematical test of students' abilities. The test is performed after the student is being treated with a learning-based Brain-Based Learning model. This interview method aims to determine the description of students' mathematical communication skills based on students' gender and phenomena that have not been seen through tests. This interview is structurally unstructured. Unstructured interviews are free interviews where researchers don't use systematically and fully organized interviews to collect data, the used interviews can be big problems lines (Sugiyono, 2016: 320).

3. Results & Discussions

After doing four studies, researchers did mathematical communication skills tests and interviews to find out the mathematical communication skills of both men and women. This interview is conducted on the selected subject to increase researchers' confidence in the data obtained from the mathematical communication capability test. This study discusses Pythagorean Theorem matter by applying the Brain-Based Learning model.

Based on the results of a test of mathematical communication capabilities consisting of six questions. From the known calculation results of the normality test data value test capability mathematical communication experiment class has a Significance value 0,105 $\geq$ 0,05 then H_0 accepted. That means the data comes from a population that distributes normally.

As a result of the mathematical communication capability test, 26 out of 31 students have reached an individual cut score of 70. Based on the calculations obtained $z_{hitung} = 1{,}14$ dan $z_{tabel} = -1{,}64$ with $\alpha = 5\%$. Because $z_{hitung} \geq z_{tabel}$ then H_0 accepted. That means that the ability to communicate mathematically with a Brain-Based Learning learning model reaches a classic height of 83.33%. It means that the ability to communicate mathematically with a Class VIII-B student with a Brain-Based Learning model has reached a classic level. This study is also consistent with the studies carried out by Sukoco and Mahmudi with a classic score of 76%.

The next test is an average difference to show the average difference in mathematical communication capabilities between male and female students. Results of calculations found with $Sig. = 0{,}062 > 0{,}05$ then H_0 accepted. It means there's no significant difference in the ability of mathematical communication between male and female students with the Brain Based Learning model. So it can be concluded that the ability of mathematical communication between male and female students through the Brain-Based Learning model.

Table 1. Summary of Mathematical Communication Ability Analysis and Interview Results

Indicator of mathematical communication ability	Subject L-01	Subject L-02	Subject L-03	Subject P-01	Subject P-02	Subject P-03
Able to connect real objects, pictures, and diagrams into mathematical ideas	able	able	able	able	able	able

Able to explain ideas, situations and mathematical relationships in writing with real objects, pictures, graphs, and algebra.	able	able	able	able	able	able
Able to express everyday events in language or mathematical symbols.	able	able	able	able	able	able
Able to make conjectures, construct arguments, and generalize.	able	able	tend to be able	able	able	tend to be able

The next test is an average difference to show the average difference in mathematical communication capabilities between male and female students. Results of calculations found with $Sig. = 0{,}062 > 0{,}05$ then H_0 accepted. It means there's no significant difference in the ability of mathematical communication between male and female students with the Brain Based Learning model. So it can be concluded that the ability of mathematical communication between male and female students through the Brain-Based Learning model.

Next, we will discuss the mathematical communication skills of male and female students. It will be explained based on the four indicators that have been determined. The following discussion refers to the results of the mathematical communication ability test and also the results of the interviews of the six research subjects. For further discussion as follows.

3.1 The indicator of mathematical communication ability 1

The indicator of mathematical communication ability 1 is being able to connect real objects, pictures, and diagrams into mathematical ideas. Both of them still have shortcomings, as in the subject of P-03 and L-03 for answer number 4 who worked on it in a hurry so that the answers they got were not quite right. However, in the process, female students tend to communicate more easily in answer sheets than male students. And male students were more thorough in writing answers than female students. So from the test data and interviews with research subjects, the mathematical communication skills of female and male students on the indicators of connecting real objects, pictures, and diagrams to mathematical ideas, there is no significant difference.

3.2 The indicator of mathematical communication ability 2

The indicators of mathematical communication skills 2 are able to explain ideas, situations and mathematical relationships in writing with real objects, pictures, graphs, and algebra. In this indicator, female students work on question number 5 with neat pictures and the right formula. Male students are able to express the situation in the problem in the form of pictures as well, but not as easily as girls. And also male students tend to be more difficult to find a solution to case number 5, from the results of interviews that male students tend to lack time to do it. From this it can be seen that the time management of female students is better than that of male students. So from the test data and interviews with the subject of the study, the ability of the mathematical communication of the female student on the indicator explains ideas, situations and mathematical relationships in writing with real things, images, graphics, and algebra better than in the male student.

3.3 The indicator of mathematical communication ability 3

The indicator of mathematical communication skills 3 is being able to express everyday events in mathematical language or symbols. In indicator 3, it is easier for female students to fully communicate the symbols and the meaning of the symbols they make. Meanwhile, male students only wrote symbols without meaning from the symbols, but in their interviews the male students were able to explain the meaning of these symbols. So from the test data and interviews with the research subjects, the mathematical communication skills of female and male students on the indicator of being able to express everyday events in mathematical language or symbols there are no significant differences.

3.4 The indicator of mathematical communication ability 4

The indicators of mathematical communication skills 4 are able to make conjectures, construct arguments, and generalize. Indicator 4 covers numbers 1 to 6 in point c. Female students subject P-01, P-02, and P-03 were able to write their arguments based on solving problems well. Meanwhile, male students tend to write short arguments. And male students, subject L-01 number 5c and subject L-03 number 6c, did not write arguments on the answer sheet for reasons of lack of time. So from the test data and interviews with research subjects, mathematical communication skills on indicators capable of making conjectures, constructing arguments, and generalizations on female students tend to be better than male students.

4. Conclusion

Based on research and understanding of the ability to communicate mathematically with the Brain-Based Learning model assessed by gender, the conclusions are as follows. (1) The ability to communicate mathematically with the Brain-Based Learning model underpinned by gender has reached a classic level. (2) In value, the ability of male and female mathematicians to communicate with the Brain-Based Learning model is not significantly different. (3) Nevertheless, some differences were found in each indicator of the ability of mathematical communication if distinguished by gender, among which women were more senior in describing the idea of the situation and mathematical relationship in writing with real objects, images, graphics, and algebraic and also female students are better at designing, formulating arguments, and generalizing than male students. But in terms of connecting real things, images, and diagrams to the idea of mathematics and also in terms of expressing everyday events in language or the symbol of mathematics between students and girls there is no significant difference.

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