

THE RELATION OF MATHEMATICAL COMMUNICATION AND LEARNING MOTIVATION TO STUDENTS' PROBLEM-SOLVING SKILLS

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ABSTRACT

This study aims to reveal the positive and significant relationship of mathematical communication and learning motivation to the problem-solving skills of Grade X Science Class Students at SMA Pondok Pesantren Modern Muhammadiyah Boarding School Yogyakarta in the academic year of 2018/2019. This is quantitative research. The research subjects are the Grade X of Science 4 Class Students at SMA Pondok Pesantren Modern Muhammadiyah Boarding School Yogyakarta in 2018/2019, as many as 36 people. The data is obtained through a test and questionnaire. The implemented instrument tests are validity and reliability test. The data analyzed using the descriptive method, statistical test, and hypothesis test. The result of the t-test on variable X_1 toward Y with $t_{\text{value}} > t_{\text{table}}$ or $1.77102 > 1.69092$ shows a positive and significant relationship of mathematical communication to students' problem-solving skills. The result of t-test X_2 toward Y with $t_{\text{value}} > t_{\text{table}}$ or $2.29088 > 1.69092$ shows a positive and significant relationship of learning motivation to students' problem-solving skills. The result of F-test X_1, X_2 toward Y with $F_{\text{value}} > F_{\text{table}}$ or $3.36743 > 3.28492$ shows that there is a positive and significant relationship of mathematical communication and learning motivation to students' problem-solving skill.

Keywords: mathematical communication, learning motivation, and problem-solving

INTRODUCTION

Mathematics is very closely related to technology. Some products that have been produced from human thought through mathematical science ranging from computers, laptops, mobile phones, tablets, and much more. The development of science and technology is moving rapidly. Humans are always required to follow these developments. Every individual must adjust to science and technology (Shovia Ulvah and Ekasatya Aldila Afriansyah, 2016: 143). Based on the results of interviews with Ustadh Muhammad Arifin, S.Pd., Si., As a mathematics teacher at the Muhammadiyah Boarding School Modern High School Yogyakarta High School on September 4, 2018, information was obtained that students' mathematical problem-solving abilities were still low. Students are only able to work on the problem according to the example problem that has been given. When given different questions, students are often confused and have difficulty doing it.

Especially questions that are developmental or varied. Mathematical communication of The mathematical is still relatively low. Students are still confused in writing mathematical ideas such as mathematical symbols and interpreting data into graphics or courtesies fields. One of the courtesies is that students have difficulty in applying mathematical formulas that use mathematical symbols. Coupled with the results of —coupled observations seen from students' mathematics notebooks, the teacher does not convey the contents. Some students are still wrong in writing mathematical ideas such as mathematical symbols and mathematical formulas. Based on direct observations on August 12, 2018, some students fell asleep when math lessons were running. This makes the learning process not smooth. The health condition of students is often disrupted. Seen students lack enthusiasm in participating in learning activities. Students still think mathematics is a complicated and unpleasant subject. This indirectly makes student learning motivation below.

From the various explanations above, researchers can formulate a problem: 1) Is there a positive and significant relationship between mathematical communication skills and problem-solving abilities of class X students of science at SMA Muhammadiyah Boarding School Modern Islamic Boarding School in Academic Year 2018/2019?, 2) Is there a positive and significant relationship between motivation to learn mathematics and problem-solving skills of class X students of science at SMA Muhammadiyah Boarding School Yogyakarta Islamic Boarding School Academic Year

2018/2019?, 3) Is there a positive and significant relationship between mathematical communication skills and motivation to learn mathematics with the problem-solving ability of class X students of science at SMA Muhammadiyah Boarding School Yogyakarta Islamic Boarding School Academic Year 2018/2019?

The research conducted by Sri Hartati, Ilham Abdullah, and Saleh Haji (2017) in Class VII students at Padang Jaya Junior High School 1, totaling 122 people consisted of 60 male students and 62 female students, regarding the influence of the ability to understand concepts, communication skills and connections to abilities solution to the problem. The results of his research showed that the direct effect of communication skills on problem-solving abilities was 0.181. That is, there is a moderate influence between the variables of communication skills and problem-solving abilities. According to Polya (1957), mathematical problem-solving consists of four main steps that must be done, namely: understanding the problem, devising a plan; carry out the plan, and check the results obtained (looking back).

Indicators in measuring mathematical communication skills (Hodiyanto, 2016: 13) as follows:

- Written describes the idea or solution of a problem or image by using their language.
 - Drawing explains ideas or solutions to mathematical problems in the form of images.
 - Mathematical expressions express everyday problems or events in mathematical models language.
- According to Hamzah B. Uno (2012: 31), learning motivation indicators are as follows.

- The desire and desire to succeed
- There is encouragement and need for learning
- There are hopes and aspirations for the future
- There is a reward for learning
- There are exciting activities in learning
- The existence of a conducive learning environment that supports student learning well.

The objectives to be achieved in this study, namely: 1) To find out there is a positive and significant relationship between mathematical communication skills and problem-solving abilities of class X students of science at SMA Muhammadiyah Boarding School Yogyakarta Islamic Boarding School Academic Year 2018/2019. 2) To find out there is a positive and significant relationship between motivation to learn mathematics and problem-solving skills of class X students of science at SMA Muhammadiyah Boarding School Modern Islamic Boarding School in Academic Year 2018/2019. 3) To find out there is a positive and significant relationship between mathematical communication skills and motivation to learn mathematics with problem-solving skills of class X students of science at SMA Muhammadiyah Boarding School Modern Islamic Boarding School in Academic Year 2018/2019.

METHODS

The type of research used in this study is quantitative research. The research design used is as follows:

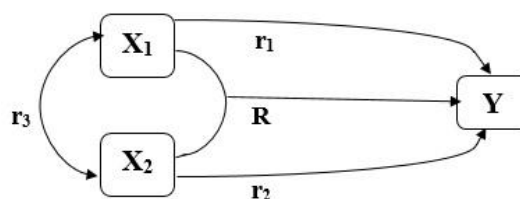


Figure 1. Scheme of Relationship between Variables in Research

Information:

X1: Mathematical Communication Ability

X2: Motivation to Learn Mathematics

Y: Mathematical Problem Solving Ability

(Sugiyono, 2017: 68)

This research was conducted at the SMA Muhammadiyah Boarding School Prambanan Islamic Boarding School in Sleman Yogyakarta Academic Year 2018/2019. The study was conducted in the even semester of the academic year 2018/2019 in class X IPA SMA Prambanan Muhammadiyah Boarding School Modern Islamic Boarding School Sleman Regency Yogyakarta. The population that the researchers took was all students of class X IPA at PPM MBS High School Yogyakarta. Before the research sample is determined, the homogeneity test will be carried out first. Based on the results of the Bartlett test, it was found that X^2 counted 7.3127863. While the size of X^2 tables with a significance level of 0.05 and the degree of freedom 4 is 9.48773. This shows that X^2 counts are smaller than the X^2 table. Therefore, a conclusion is drawn that the distribution of data in the population is homogeneous. The sampling technique through this research is random sampling.

The class chosen by lottery is class X IPA 3 as the pilot class and class X IPA 4 as the sample class. This study uses three types of instruments: tests of mathematical communication skills, tests of problem-solving abilities, and motivation to learn mathematics. Questionnaire for motivation to learn mathematics, tests of mathematical communication skills, and problem-solving ability tests were validated by Drs.Uus Kusdinar., M.Pd. who is a lecturer in Mathematics Education. Validated aspects are material aspects, construction, and cultural language. The three instruments were declared valid and feasible to be used in this study. They measure the reliability of mathematics learning motivation questionnaire instruments, tests of mathematical communication skills, and problem-solving abilities using the Alpha formula because of interval instruments and descriptions.

Table 1. Research instrument Reliability Test Results

Variable	$R_{calculates}$	Category	Conclusion
X_1	0,839	Very High	Reliability
X_2	0,875	Very High	Reliability
Y	0,57	Fairly	Reliability

Information:

X_1 : Mathematical Communication Ability

X_2 : Motivation to Learn Mathematics

Y: Mathematical Problem Solving Ability

RESULT AND DISCUSSION

Table 2. Distribution of Number of Students by Category Value of Mathematical Communication Ability

Category	Value	F	%
High	$X > 90,34195$	8	22,2
Medium	$80,65805 \leq X \leq 90,34195$	19	52,7
Low	$X < 80,65805$	9	25
Total		36	100

Based on the results of the categorization above, it can be concluded that the mathematical communication skills of class X students at the Muhammadiyah Boarding School Modern Islamic Boarding School in Yogyakarta in the 2018/2019 school year are in the moderate category. This is because the frequency or the largest percentage is at intervals of $80.65805 \leq X \leq 90.34195$, which is 19 or 52.7%.

Table 3. Distribution of Number of Students by Category Motivation to Learn Mathematics

Category	Value	F	%
High	$X > 74,08017$	4	11,1
Medium	$57,67 \leq X \leq 74,08017$	26	72,2
Low	$X < 57,67$	6	16,7
Total		36	100

Based on the categorization of Table 3, it can be concluded that the motivation to learn mathematics in class X students at SMA Muhammadiyah Boarding School Yogyakarta Islamic Boarding School 2018/2019 is in the medium category. This is evidenced by the frequency or the largest percentage in the interval of $56.67 \leq X \leq 74.08017$, as much as 19 or 72.2%.

Table 4. Distribution of Number of Students by Category
Value of Problem Solving Ability

Category	Value	F	%
High	$X > 91,07746$	8	22,2
Medium	$77,81142 \leq X \leq 91,07746$	23	63,8
Low	$X < 77,81142$	5	13,8
Total		36	100

Based on the categorization of Table 4, a conclusion can be drawn that the problem-solving abilities of class X students at SMA Muhammadiyah Boarding School Yogyakarta Modern Islamic Boarding School are in the moderate category. This is because the most considerable frequency or percentage is in the interval $77.81142 \leq X \leq 91.07746$, which is 23 or 63.8889%.

The normality test is used to determine the distribution of data from each study variable with the normal or abnormal distribution. In this study, the normality test uses the chi-square formula chi-square (χ^2). Data from each research variable is said to be expected if $\chi_{count}^2 \leq \chi_{table}^2$ with a significance level of $\alpha = 5\%$ and degrees of freedom $k-1$. The value of k that satisfies the operation is the number of interval classes in each research variable. The following will be presented the results of the normality test of the three variables studied.

Table 5. Normality Test

Variable	χ_{count}^2	χ_{table}^2	Dk	Information
Mathematical Communication Ability (X_1)	2,8659	9,4877	4	Normal
Motivation to Learn Mathematics (X_2)	1,8239	11,0705	5	Normal
Mathematical Problem Solving Ability (Y)	3,8149	11,0705	5	Normal

Based on Table 5, it can be noted that the magnitude of χ_{count}^2 for each research variable is smaller than χ_{table}^2 , so it can be concluded that the distribution of data for each variable is normally distributed.

The independence test was conducted to test for the presence or absence of a relationship between two independent variables: mathematical communication skills (X_1) and mathematics learning motivation (X_2). Like the normality test, the independence test uses the chi-square formula chi-square (χ^2) with a significance level of $\alpha = 5\%$. The degrees of freedom used are $dk = (b-1)(k-1)$ with b , and k are many. Decision making refers to $\chi_{count}^2 \leq \chi_{table}^2 = (b-1)(k-1)$ is concluded to be independent. The following will be presented as a table of independence test results between mathematical communication skills (X_1) and mathematics learning motivation (X_2).

Table 6. Independence Test Results

Variable	χ_{count}^2	χ_{table}^2	Dk	Information
X_1 with X_2	11,667	31,410	20	Independent

Based on Table 6, it can be seen that the value of χ_{count}^2 is smaller than χ_{table}^2 , so it can be concluded that the relationship between mathematical communication ability variables (X_1) and motivation to learn mathematics (X_2) is independent.

The linearity test is used to test between mathematical communication ability variables (X_1) with problem-solving abilities (Y) and mathematics learning motivation (X_2) with the problem-solving ability (Y) having a linear or not linear relationship. In testing linearity, the formula used is a linear regression with the F-test. Decision making refers to the significance level $\alpha = 5\%$ with db numerator = $k-2$ and db denominator = $n-k$. In this study the db numerator = 3 and db denominator = 31 for X_1 with

Y. As for X_2 with Y, db numerator = 19 and db denominator = 15. Between variables said to be linear if $F_{\text{count}} \leq F_{\text{table}}$. The following will be presented in the results of the linearity test in Table 7.

Table 7. Linearity Test Results

Variable	F_{count}	F_{table}	Information
X_1 with Y	1,800561	2,911334	Linear
X_2 with Y	1,910403	2,339819	Linear

Based on Table 7, it can be seen that between mathematical communication ability variables (X_1) with problem-solving abilities (Y) and mathematical learning motivation (X_2) with problem-solving abilities (Y), each F_{count} value is smaller than F_{table} . Thus, a conclusion can be drawn that each independent variable with the dependent variable is linear.

After conducting the prerequisite test, the next step is to test the hypotheses in the study. The following will explain the results of testing the hypothesis. In testing this first hypothesis, a simple correlation coefficient is obtained, denoted by r of 0.290617613. The next step is to test the significance level of the correlation coefficient using the t-test. The significance level is $\alpha = 5\%$ with $v = n-2$ where n is the number of students. Decision making is based on if $t_{\text{count}} > t_{\text{table}}$, then $H_{0,1}$ is rejected. Through this research, the value of $t_{\text{count}} = 1.7710156371$ and $t_{(\text{table } (0.05; 36-2))} = 1.69092$. Because $t_{\text{count}} > t_{\text{table}}$, then $H_{0,1}$ is rejected. So, it can be concluded that there is a positive and significant relationship between mathematical communication skills and mathematical problem-solving abilities of class X IPA even semester students at SMA Muhammadiyah Boarding School Yogyakarta Modern Islamic Boarding School 2018/2019. In addition to the above, based on the results of data analysis obtained, a simple regression equation Y over X_1 , namely, $\hat{Y} = 57.12275732 + 0.328611898 X_1$. In testing this second hypothesis, a simple correlation coefficient is obtained denoted by r of 0.365673444. The next step is to test the significance level of the correlation coefficient using the t-test. The significance level is $\alpha = 5\%$ with $v = n-2$ where n is the number of respondents. Decision making is based on $t_{\text{count}} > t_{\text{table}}$, then $H_{0,2}$ is rejected. Through this research, $t_{\text{count}} = 2.290883487$ and $t_{(\text{table } (0.05; 36-2))} = 1.69092$. Because $t_{\text{count}} > t_{\text{table}}$, then $H_{0,2}$ is rejected. So, it can be concluded that there is a positive and significant relationship between motivation to learn mathematics with mathematical problem-solving abilities of class X students in the even semester at SMA Muhammadiyah Boarding School Yogyakarta Modern Islamic Boarding School 2018/2019. In addition to the above, based on the results of data analysis obtained, a simple regression equation Y over X_2 , namely $\hat{Y} = 67.29674991 + 0.26902364 X_2$. In testing this third hypothesis, the correlation coefficient value obtained from R's double analysis is 0.411697732. The next step is to test the significance level of the correlation coefficient using the F-test. The significance level is $\alpha = 5\%$ with $v_1 = k-1$ and $v_2 = n-k$ where $k =$ number of research variables, $n =$ many respondents. Decision making is based on $F_{\text{count}} > F_{\text{table}}$, then $H_{0,3}$ is rejected. Through this research, the value of $F_{\text{count}} = 3.36743$ and $F_{(\text{table } (0.05; 2; 33))} = 3.284917651$. Because $F_{\text{count}} > F_{\text{table}}$, then $H_{0,3}$ is rejected. So, it can be concluded that there is a positive and significant relationship between mathematical communication skills and motivation to learn mathematics with mathematical problem-solving abilities of class X students of the even semester at SMA Muhammadiyah Boarding School Yogyakarta Modern Islamic Boarding School 2018/2019. In addition to the above, based on the results of data analysis, it was found that multiple linear regression equations for X_1 and X_2 were $\hat{Y} = 51.16304691 + 0.224322307 X_1 + 0.225010547 X_2$. Based on the results of the relative contribution (RC) and the effective contribution (EC), data is obtained as shown in Table 8 below

Table 8. Results of Calculation of Relative and Effective Donations of X_1 and X_2

Variable	RC	EC
Mathematical Communication Ability (X_1)	34,0154 %	5,76545 %
Motivation to Learn Mathematics (X_2)	65,9846 %	11,1841 %
Total	100%	16,94955 %

This study aims to determine the relationship between mathematical communication skills (X_1), mathematics learning motivation (X_1) with mathematical problem-solving abilities of students (Y) in class X at SMA Muhammadiyah Boarding School Yogyakarta Modern Islamic Boarding School even semester 2018/2019 academic year. In this process, further discussion of the results of the research correlation analysis was carried out. Based on the results of the study, researchers found that. The first hypothesis test results concluded a positive and significant relationship between mathematical communication skills (X_1) with mathematical problem-solving abilities (Y). This shows that the better the mathematical communication skills students have, the better their problem-solving skills. Students can improve mathematical communication skills by getting used to working on problems related to symbols, graphics, and so on. The more questions associated with it will increase students' knowledge so that students do not feel alien to the symbols or graphics they have just seen.

A simple correlation coefficient r of 0.290617613 was obtained with a significance level of 5% and $v = 34$. Meanwhile, the determinant coefficient symbolized by r^2 is obtained at 0.084458597. This shows that students' mathematical communication skills influence 8.4458597% of mathematical problem-solving abilities, and other factors influence the rest. Through linear lines $\hat{Y} = 57.12275732 + 0.328611898 X_1$, it can be explained that each increase of one unit X_1 causes a 0.328611898 increase to Y . The result of this study is that there is a positive and significant relationship between mathematical communication skills and problem-solving abilities problem-solving is. This supports the research of Rezi Ariawan and Hayatun (2017), Sri Hartati, Ilham Abdullah, and Saleh Hajj (2017). Based on the second hypothesis test results, it was concluded that there was a positive and significant relationship between motivation to learn mathematics (X_2) and mathematical problem-solving abilities (problem-solving that the higher learning motivation possessed by students, the greater the students' problem-solving abilities. The teacher plays a role in stimulating motivation in students so that the spirit of learning. This is needed to facilitate the process of thinking and solving mathematical problems. Students can also motivate themselves by doing positive things and become a reference forgiving action to oneself.

The simple correlation coefficient r is 0.365673444, with a significance level of 5% and $v = 34$. Meanwhile, the determinant coefficient symbolized by r^2 is obtained at 0.133717068. This shows that 13.3717068% of mathematical problem-solving abilities are influenced by the motivation to learn mathematics, and other factors influence the rest. The linear line $\hat{Y} = 67.29674991 + 0.26902364 X_2$ shows that each increase in one unit X_2 results in a 0.26902364 increase in Y . This study's result is a positive and significant relationship between motivation to learn mathematics and mathematical problem-solving abilities students. This supports the research of Awaluddin Makaraka (2018), Andriani Eka Wulandari, Ervin Azhar, and Hella Jusra (2018), Wahyuddin (2016), and Fattah Nur Akbar (2016). Based on the results of the third hypothesis test, it was concluded that there was a positive and significant relationship between mathematical communication skills (X_1) and mathematics learning motivation (X_2) with mathematical problem-solving abilities (Y). This shows that better mathematical communication skills students have, and coupled with high learning motivation, students easily solve mathematical problems. In addition, obtained a multiple R correlation coefficient of 0.508019 with a significance level of 5% and $v_1 = 2$ and $v_2 = 33$. Meanwhile, the determinant coefficient symbolized by R^2 is obtained at 0.1695. This shows that 16.95% of mathematical problem-solving abilities are influenced by mathematical communication skills and mathematics learning motivation, and other factors influence the rest. Through the linear line $\hat{Y} = 51,16304691 + 0,224322307 X_1 + 0,225010547 X_2$, it can be explained that each increase of one unit X_1 causes an increase of 0.224322307 to Y and an increase of one unit X_2 results in 0.225010547 increase to Y . Next, the relative contribution of X_1 was 34.0154%, and X_2 was 65.9846%. In contrast, the effective contribution of X_1 was 5.76545%, and X_2 was 11.1841%.

CONCLUSION

Based on the results of the research that the researchers did, some conclusions can be drawn as follows:

1. There is a positive and significant relationship between mathematical communication skills and mathematical problem-solving abilities of class X students at SMA Muhammadiyah Boarding School Yogyakarta Islamic Boarding School even semester academic year 2018/2019.
2. There is a positive and significant relationship between motivation to learn mathematics with mathematical problem-solving abilities of class X students at SMA Muhammadiyah Boarding School Yogyakarta Modern Islamic Boarding School even semester academic year 2018/2019.
3. There is a positive and significant relationship between mathematical communication skills and motivation to learn mathematics with mathematical problem-solving abilities of class X students at SMA Muhammadiyah Boarding School Yogyakarta Modern Islamic Boarding School 2018/2019 academic year.

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