THE EFFECT OF MATHEMATIC LITERATION AND CRITICAL THINKING ABILITY ON MATHEMATICS PROBLEM-SOLVING ABILITY

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ABSTRACT

The repetition of SMA Negeri 4 Yogyakarta students shows that students' ability to solve mathematical problems is still low. This study aims to determine: (1) is there an effect of mathematical literacy on the ability to solve mathematics problems in class X State Senior High School (SMA Negeri) 4 Yogyakarta; (2) is there the effect of critical thinking on the ability of class X math problem-solving at SMA Negeri 4 Yogyakarta; (3) is there any effect of mathematical literacy and critical thinking on the ability of class X math problem-solving at SMA Negeri 4 Yogyakarta in the 2019/2020 school year. This research is a correlational quantitative associative study. This study's sample was students of class X MIPA 4 and X IPS 1 odd semester of SMA Negeri 4 Yogyakarta in 2019 / 2020. Data collection techniques were a breakdown test for mathematical literacy and problem-solving while a multiple-choice test for critical thinking questions. Research instrument test: validation test and reliability test. Analysis prerequisite test: normality test. Data analysis uses simple regression analysis, multiple regression, relative and effective contributions. Research instruments in the form of mathematical literacy questions, critical thinking, and problem-solving. This study's results indicate a positive influence of mathematical literacy and critical thinking together on the ability to solve problems with Rx (1,2) y = 0.562, F_{count}= 14.105, and the regression equation $\hat{Y} = -0{,}845 + 0{,}545\,X_1 + 0{,}049X_2$. However, the effect of mathematics literacy ability on the problem-solving ability of class X students of SMA Negeri 4 Yogyakarta is greater than the effect of critical thinking skills on class X students' problem-solving skills SMA Negeri 4 Yogyakarta.

Keywords: Problem Solving, Mathematical Literacy, Critical Thinking.

INTRODUCTION

Mathematics is a subject that is introduced in kindergartens and is taught in elementary schools to tertiary institutions. The purpose of this teaching is to develop thinking and problem-solving skills, both in mathematics, other fields, or daily life (Abidin, Mulyati, & Yunansah, 2017). Thus problem-solving is part of mathematics. Problem-solving is a cognitive strategy that is needed in everyday life, including students in learning activities. Problem-solving is one of life's tasks that must be faced daily in an easy to a complex range (Surya: 2015).

Problem-solving is the process of accepting a problem as a challenge to solve the problem. Problem-solving is important for learning mathematics. If students are accustomed to being faced with the problems they face, they will get used to using their thought patterns (Sundayana, 2016). According to Polya, the problem-solving process is divided into four aspects. These aspects are understanding the problem, planning the problem solving, solving the problem according to the plan, and checking again (Polya, 1957). Based on the teacher's daily test documentation, 83,884% of students had not yet reached the Minimum Completeness Criteria (MCC) score of 70. This showed that the results achieved by students were still low. The material on the daily test includes several questions, including a story problem that requires problem-solving. So these results also show their ability to solve mathematical problems that are still low.

From the results of these observations, a problem was found in students not reading and understanding mathematical problems and then applied to solve mathematical problems appropriately. This ability is part of mathematical literacy so that the ability of students' mathematical literacy is not good.

Learning mathematics is not only aimed at increasing the ability to count. At this time, this ability is not enough to deal with increasingly complex problems in everyday life. The ability to count is only a small part of Mathematics. The National Council of Teachers of Mathematics (NCTM) applies five mathematical abilities in learning Mathematics. These five abilities are abilities that must be mastered by students after learning mathematics, namely mathematical reasoning, mathematical representation, mathematical connections, mathematical communication, and mathematical problem-solving. The five mathematical abilities are very important to be mastered related to solving problems encountered in everyday life (Abidin, Mulyati, & Yunansah: 2017).

Mathematical literacy is the ability that supports the development of the five mathematical abilities termed mathematical power. Mathematical power is the ability to deal with mathematical problems. The term mathematical literacy is not explicitly listed, but the component of mathematical literacy is the abilities needed to achieve mathematical power (Abidin, Mulyati, & Yunansah, 2017). In the main study of the Program for International Student Assessment (PISA), there are three literacies, namely, reading literacy (reading literacy), mathematical literacy (scientific literacy), and scientific literacy (Organization for Economic Co-operation and Development (OECD), 2015). Mathematical literacy is the students' ability to formulate, apply, and interpret mathematics in various contexts, including mathematical reasoning and use concepts, procedures, and facts to explain, describe, and predict an event. Mathematical literacy is critical for everyone to solve everyday problems (Purwasih, Sari, & Agustina, 2018). Because of that, in its application, mathematical literacy is related to problem-solving.

There are two kinds of thinking: thinking with the left brain and thinking with the right brain. Thinking with the left brain is more rational, logical, critical, analytical, and gives consideration. Whereas thinking with the right brain has abstract, conceptual, creative, imaginative, and intuitive characteristics. At the same time, critical thinking is more to the left, focusing on analyzing and developing various possibilities. Creative thinking is more to the right that focuses on making and communicating new relationships (Surya, 2015). The thought process needed in working on problem-solving problems is critical thinking because when working on left-brain problems, more needed. Based on the teacher's facts, low student thinking ability seen from students has not been able to make conclusions correctly. Besides that, students are also not able to understand the problem well. This shows that Shiva's thinking ability is still lacking.

Critical thinking competence is the ability to use one's thinking power and reasoning power to be able to criticize various phenomena that are happening around him. Usually begins with a person's sensitivity to something, then followed by the ability to evaluate or assess it according to the point of view used (Abidin, Mulyati, & Yunansah, 2017). Critical thinking consists of logical and analytic thinking. Logical thinking uses natural thinking flow but is controlled by a mechanism of knowing and labeling without identity. Logic thinking has advantages in controlling and refining natural thinking flow (Rusyna: 2014).

This research was conducted with the following objectives: (1) To find out whether there was an effect of mathematical literacy on the ability of class X math problem-solving at SMA Negeri 4 Yogyakarta; (2) to determine whether there is an effect of critical thinking on the ability to solve math problems in class X SMA Negeri 4 Yogyakarta; (3) to find out whether there is an effect of mathematical literacy and critical thinking on the ability to solve mathematics problem class X SMA Negeri 4 Yogyakarta in the 2019/2020 school year.

METHODS

The method used in this study is a survey method with a quantitative approach. At the same time, the type of research used is correlational associative. The variables studied used three variables: the independent variables (X_1) and (X_2), influence, or cause variables. In this study, the independent variables are the ability of mathematical literacy and critical thinking skills. At the same time, the dependent variable is the problem-solving ability (Y). The study's objectives chose this method, and

researchers wanted to find out how the influence between mathematical literacy skills and critical thinking on students' mathematical problem-solving abilities. This research was carried out in SMA Negeri 4 Yogyakarta in the odd semester of 2019/2020. This study included all students of class X SMA Negeri 4 Yogyakarta, totaling 269 students. Simultaneously, the samples involved in this study were 64 students consisting of two classes: class X Mathematics 4 and 34 students and X social science, one as many as 30 students. To get the data in this study used a question instrument to determine mathematical literacy, critical thinking, and mathematical problem-solving—the instrument of mathematical literacy and mathematical problem-solving in the form of essay questions. At the same time, the problem of critical thinking is multiple choice. This study aims to look at mathematical literacy and critical thinking on students' mathematical problem-solving. Analysis of the data used includes analysis of regression results to see mathematical problem-solving.

RESULTS AND DISCUSSION

The data obtained in this study are the results of tests of mathematical literacy ability, critical thinking, and problem-solving of mathematics in class X students of SMA Negeri 4 Yogyakarta. The data is processed to find out the average student scores on each test. The test results are presented in Table 1 as follows.

Table 1. Average Student Grades

Result	Mathematical Literacy	Critical Thinking	Problem Solving
$\bar{x}$	79,34	62,06	45,43
S	17,03	14,73	17,18

Information :
$\bar{x}$= average value
S = standard deviation

Based on the data in Table 1, it is known that the average value of mathematics literacy for class X students is 79.34, the average value of critical thinking for class X students is 62.06, and the average value of problem-solving for class X students is 45.43. From these results, it can be seen that the ability to think critically and problem-solving skills of class X students is still low, with an average value less than the MCC of SMA Negeri 4 Yogyakarta by 70.

Before analyzing the data, a normality test is needed to determine whether the results of student grades can be analyzed using parametric statistical tests. The normality test includes variables X_1, X_2, and Y. The normality test results are presented in Table 2 as follows:

Table 2. Normality Test Results

Variable	Chi-Squared Table	Chi-Squared Count	Information
X_1	14,067	12,714	Normal
X_2	15,507	11,756	Normal
Y	14,067	7,750	Normal

Table 2, the calculated chi-squared value for variable X_1 is less than the chi-squared table or 12,714 <14,067, so the data is normally distributed. Chi-square value calculated for variable X_2 is less than the chi-squared table or 11.756 <15.507, so the data is normally distributed. The Y variable is calculated for a chi-squared value of less than the chi-squared table or 7,750 <14,067, so the data is normally distributed. Therefore calculations can use parametric statistical tests.

To determine how much the value of the variables X_1, X_2, and Y use the t-test with the right-hand side test. It says the right-hand test because the price of the t_{table} is placed on the right side of the curve. T-test results are presented in Table 3 as follows:

Table 3. Test-t Results

Variable	t_{table}	t_{count}
X_1	1,998	14,493
X_2	1,998	1,121
Y	1,998	-6,782

Based on the data in table 3, it can be seen the number of mathematical literacy skills, critical thinking skills, and problem-solving abilities.

The first data to be tested is for the mathematical literacy variable; the hypothesized value is 60% of the ideal value. With the result $t_{count} = \frac{\bar{x}-\mu_0}{s/\sqrt{n}}$ = 14,493. The price of t arithmetic is then compared with the t table's price, with degrees of freedom (db) = N-1 = 64-1 = 63 and the level of error α = 5% for one-party test obtained t_{table}= 1.998. Because t arithmetic is greater than t_{table} or 14.493> 1.998, H_o is rejected, and H_a is accepted. So the hypothesis states that students' mathematical literacy is still as low as 60% of the criterion score is not accepted, or there is a difference between what is suspected in the population and the data collected from the sample. So the mathematical literacy ability of students in class X of SMA Negeri 4 Yogyakarta is already high.

The second data to be tested is for the critical thinking variable; the hypothesized value is at most 60% of the ideal value. With the results of $t_{count} = \frac{\bar{x}-\mu_0}{s/\sqrt{n}}$ = 1.121. The price of t arithmetic is then compared with the t table's price, with degrees of freedom (db) = N-1 = 64-1 = 63 and the level of error α = 5% for one-party test obtained t_{table}= 1.998. Because t arithmetic is smaller than t_{table} or 1.1211 <1.998, H_o is accepted, and H_a is rejected. So the hypothesis states that students' critical thinking is still low because, at most, 60% of the criterion value can be accepted, or there is no difference between what is suspected in the population with the data collected from the sample. So that the critical thinking skills of students in class X of SMA Negeri 4 Yogyakarta are still low.

The second data to be tested is for the mathematical literacy variable. The value that is hypothesized is at most 60% of the ideal value. With the results of $t_{count} = \frac{\bar{x}-\mu_0}{s/\sqrt{n}}$ = -6.782. The price of t arithmetic is then compared with the t table's price, with degrees of freedom (db) = N-1 = 64-1 = 63 and the level of error α = 5% for one-party test obtained t_{table}= 1.998. Because t arithmetic is smaller than t_{table} or -6.782 <1.998, H_o is accepted, and H_a is rejected. So the hypothesis states that students' problem-solving is still as low as at most 60% of the criterion scores is acceptable, or there is no difference between those predicted in the population with the data gathered from the sample. So that the problem-solving ability of students in class X of SMA Negeri 4 Yogyakarta is still low.

After that, the data were analyzed to determine each variable's effect, namely X_1 and X_2 on the Y variable and the influence of the X_1 and X_2 variables together on the Y variable. The first analysis was carried out to determine the effect of the X_1 variable on the Y variable. The analysis conducted is simple regression, relative contribution, and effective contribution. The data are presented in Table 4 as follows:

Table 4. Analysis Results of Effect X_1 on Y

Variable	**Coefficient**	r_{x1y}	r^2_{x1y}	F_{count}	t_{count}	**Information**
A constant	0,504					
x_1	0,566	0,561	0,315	28,499	3,338	Positive

In Table 4, the value of is 0.504, while the value of b is 0.566. So the regression equation can be written $\hat{Y} = 0{,}504 + 0{,}566X$. The equation shows that the value of the regression coefficient is positive at 0.566. If the value of mathematical literacy ability (X_1) increases by one unit, the problem-solving ability (Y) increases by 0.566.

The correlation coefficient is based on the calculated r-value of the output table for the relationship between mathematical literacy (X_1) with problem-solving (Y) of 0.561> r table of 0.246,

which means there is a relationship or correlation between mathematical literacy variables (X_1) and problem-solving (Y). Because the r count in this analysis is positive, there is a relationship between the mathematics literacy variable (X_1) and problem-solving (Y), which is positive. In other words, increasing literacy ability will increase students' problem-solving abilities. The magnitude of the value of correlation or relationship (R) is equal to 0.561, and the coefficient of determination (R^2) is 0.315. The influence of independent variables on the dependent variable is 31.5%, while the rest is influenced by other variables not examined in this study.

F-test that uses the hypothesis si H_0: There is no linear relationship between mathematical literacy variables ($X1$) and problem-solving (Y) bor H_1: There is a linear relationship between mathematical literacy variables (X_1) and problem-solving (Y). The calculated F value from the obtained is 28.499. Whereas F_{table} with α = 5% and df = n-k = 64-2 = 62, i.e. $F_{(\alpha,\ 1,\ n-2)}$ = 3.996. Because F_{count} is more than t_{table} (28,499> 3,996), H_0 is rejected, or H_1 is accepted. In other words, there is a linear relationship between mathematical literacy variables (X_1) and problem-solving (Y).

The next t-test with the hypothesis is H_0: There is no positive influence between the mathematics literacy variable (X_1) and problem-solving (Y) or H_1: There is a positive influence between the mathematics literacy variable (X_1) and problem-solving (Y). T value is calculated from table 5.338 while t_{table} with α = 5% and df = n-k = 64-2 = 62, i.e. (α / 2; n-2) = 2.295. Because t arithmetic is more than t_{table} (5.338> 2.295), H_0 is rejected, or H_1 is accepted. In other words, there is a positive influence between mathematical literacy variables (X_1) and problem-solving (Y). So that mathematics literacy ability affects the problem-solving ability of class X students of SMA Negeri 4 Yogyakarta in this study.

Next, the second analysis is carried out to determine the effect of variable X_2 on variable Y. The analysis conducted is simple regression, relative contribution, and effective contribution. The results of the analysis are presented in Table 5 as follows:

Table 5. Analysis Results of Effect X_2 on Y

Variable	Coefficient	r_{x1y}	r^2_{x1y}	F_{count}	t_{count}	Information
A constant	22,807					
x_2	0,365	0,312	0,098	6,4707	2,590	Positive

In Table 5, the value of a is 22,807, while the value of b is 0,365. So that the regression equation can be written $\hat{Y} = 22{,}807 + 0{,}365\ x$. The equation shows that the regression coefficient value is positive at 0.365, which means that if the value of critical thinking (X_2) goes up by one unit, then problem-solving (Y) increases by 0.365.

The correlation coefficient is based on the calculated r-value of the output table for the relationship between critical thinking (X_2) with problem-solving (Y) of 0.312> r table of 0.246, which means there is a relationship or correlation between critical thinking variables (X_2) with problem-solving (Y). Because the r count in this analysis is positive, there is a relationship between the variable of critical thinking (X_2) and problem-solving (Y). In other words, the increasing ability to think critically will increase students' problem-solving abilities. The magnitude of the value of correlation or relationship (R) is equal to 0.312, and the coefficient of determination (R^2) is 0.098. The influence of independent variables on the dependent variable is 9.8%, while the rest is influenced by other variables not examined in this study.

F test that uses hypothesis: H_0: There is no linear relationship between the variables of critical thinking (X_2) and problem-solving (Y) or H_1: There is a linear relationship between the variables of critical thinking (X_2) and problem-solving (Y). The calculated F from the table is 6.707 while the F table with α = 5% and df = n-k = 64-2 = 62, i.e. F (α, 1, n-2) = 3.995. Because F_{count} is more than t_{table} (6.707> 3.995), H_0 is rejected, or H_1 is accepted. In other words, there is a linear relationship between critical thinking variables (X_2) and problem-solving (Y).

The next t-test with the hypothesis is H_0: There is no positive influence between the variable of critical thinking (X_2) and problem-solving (Y) or H_1: There is a positive influence between the variable of critical thinking (X_2) and problem-solving (Y). T value is calculated from table 2,590 while t_{table} is α = 5% and df = nk = 64-2 = 62, i.e. (α / 2; n-2) = 2,295 Because t_{count} is more than t_{table} (2,590> 2,295) then H_0 is rejected or H_1 is accepted, in other words there is a positive influence between the variable of critical thinking (X_2) and problem-solving (Y). Critical thinking skills affect the problem-solving ability of class X students of SMA Negeri 4 Yogyakarta in this study.

The last data analysis is to find out the influence between X_1 and X_2 variables on Y variables. The analysis conducted is multiple regression, relative contribution, and effective contribution. The results of data analysis are presented in table 6 as follows:

Table 6. Analysis Results of Effect X_1 and X_2 on Y

Variable	Coefficient	$r_{x(1,2)y}$	$r^2{}_{x(1,2)y}$	F_{count}
A constant	-0,845			
x_1	0,545			
x_2	0,049	0,562	0,316	14,105

Based on Table 6 the results obtained bo = -0,845 b1 = 0.545 and b2 = 0.049. So the regression line equation is $\hat{Y}$= -0.845 + 0.545 x_1 + 0.049 x_2. These results indicate that the value of the regression coefficient positif1 is positive at 0.545, which means that if the value of mathematical literacy (X_1) increases by one unit, the value of problem-solving will increase by 0.545, the assumption still fixed. The regression coefficient X_2 is positive at 0.049, which means that if the value of critical thinking (X_2) goes up by one unit, then problem-solving (Y) rises by 0.049 with the assumption X_1 fixed.

The correlation coefficient is 0.562, and the r table is 0.246. Because 0.562> 0.246 or r count more than r table, which means there is a relationship or correlation between mathematical literacy variables (X_1) and critical thinking (X_2) with problem-solving (Y). Because the r count in this analysis is positive, it means that there is a relationship between mathematical literacy variables (X_1) and critical thinking (X_2) together have a positive effect on problem-solving (Y). The simulative contribution or contribution of mathematics literacy and critical thinking ability variables affects problem-solving ability by 31.6%. In comparison, the remaining 68.4% is determined by factors or other variables not examined in this study. In addition to the F-test, the calculated F value is obtained, namely F_0 = 14.105 using α = 5%, the F_{table} value = 3.995 is obtained. Because 14,105> 3,995 or F_{count} are more than F_{table}, H_0 is rejected, or there is an influence jointly between the variables of mathematical literacy and critical thinking on problem-solving abilities. The magnitude of the correlation value or the relationship (R) X_1 to Y is equal to 0.561, and the coefficient of determination (R^2) is 0.315. While the magnitude of the value of the correlation or relationship (R) X_2 to Y is equal to 0.312 and the coefficient of determination (R^2) of 0.098. Because 0.561> 0.315, the correlation or relationship between mathematics literacy ability and problem-solving ability of class X students of SMA Negeri 4 Yogyakarta is greater than the ability to think critically about problem-solving abilities of class X students of SMA Negeri 4 Yogyakarta.

CONCLUSION

Based on the results of the analysis of research data and discussion that has been described, it can be concluded that

1. There is a positive effect on mathematical literacy's ability to solve class X students of SMA Negeri 4 Yogyakarta in Academic Year 2019/2020, with $rx1y$ = 0.561; F_{count} = 28.499, and t_{count} = 5.338 at the 5% significance level. $\hat{Y}$ = 0.504 + 0.566x. This shows that the higher the mathematical literacy ability, the higher the problem-solving ability.
2. There is an effect of thinking critically on solving math problems in class X SMA Negeri 4 Yogyakarta in Academic Year 2019/2020, with $rx2y$ = 0.312 .; F_{count} = 6.707, and t_{count} = 2.590 at

the 5% significance level. $\hat{Y}$=22.807 + 0.365 x. This shows that the higher the critical thinking ability, the higher the problem-solving ability.

3. There is a common effect of mathematical literacy and critical thinking on solving math problems in class X SMA Negeri 4 Yogyakarta in Academic Year 2019/2020 with $rx1,2y$ = 0.562 .; F_{count} = 14.105 at the 5% significance level. $\hat{Y}$=-0.845 + 0.545 x_1 + 0.049 x_2. The mathematical literacy ability of the problem-solving abilities of class X students of SMA Negeri 4 Yogyakarta is greater than the ability to think critically of class X students of SMA Negeri 4 Yogyakarta.

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