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THE EFFECT OF MATHEMATICAL DISPOSITION AND LEARNING MOTIVATION ON PROBLEM SOLVING: AN ANALYSIS

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ABSTRACT

This research was motivated by the low problem solving abilities, mathematical disposition and learning motivation of junior students. This study aims to find and analyze empirically the influence of mathematical dispositions and learning motivation on problem solving abilities. Samples were obtained in class VII-2 at SMPN 2 Cimahi as many as 34 students. Study uses correlational quantitative methods. Analysis was done by regression method. The data collection was given 2 pieces of study instruments, namely problem solving test instruments and non-test questionnaires in a set of mathematical dispositions and learning motivation. The data was tested for regression and correlation. The results of data analysis that was mathematical disposition and larning motivation were significantly influenced by problem solving ability of junior students, with the regression equation $\hat{Y} = 1.95 + 0.121\,X_1 + 0.015X_2$ indicating a positive influence, and the degree of closeness is the Pearson correlation coefficient of 0.827 classified in a strong positive interpretation. Together, mathematical disposition variables and learning motivation variables can determine the problem solving variable by 68.3%. Recommendations from this study, teachers should design learning processes that can improve mathematical disposition and student motivation so that students' problem solving abilities increase.

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1. INTRODUCTION

Problem solving is one of the abilities that need to be owned and developed by every student at the secondary education level. The rationale of the statement includes mathematical problem solving was the ability listed in the curriculum and objectives of the 2006 KTSP mathematics learning and 2013 mathematics curriculum which states that the purpose of mathematics learning was to solve problems that includes the ability to

understand problems, design mathematical models, solve model, and interpret the solutions obtained (Hendriana, Rohaeti, & Sumarmo, 2017).

Cooney (Hendriana & Sumarmo, 2014) suggests that ownership of problem solving ability helps students think analytically in making decisions in daily life and helps improve the ability to think critically in dealing with new situations. Thus the mathematical problem solving abilities are very important for students. The importance of ownership of problem solving abilities is reflected in the quote Branca (1980) which states that mathematical problem solving is one of the important goals in learning mathematics even the mathematical problem solving process is the heart of mathematics.

Polya (2004) developed a model, procedure, or heuristic problem solving consisting of steps to solve a problem, namely (1) understanding the problem; (2) devising a plan; (3) carrying out the plan; and (4) looking back. Understanding problems refers to identifying facts, concepts, or information needed to solve problems. Devising a plan refers to the preparation of mathematical models of known problems. Carrying out the plan refers to the completion of the mathematical model that has been compiled. While looking back it relates to examining the suitability or correctness of answers. The stages of problem solving proposed by Polya (2004) can be seen as aspects that need to be considered in evaluating problem solving abilities. In other words, mathematical problem solving abilities include the ability to understand problems, make a problem solving plan, implement a problem-solving plan, and examine solutions.

Based on the description above it is clear that the mathematical problem solving abilities of students need to get attention to be developed. Mathematical problem solving ability required to learn and mathematics it self. Therefore solving mathematical problems is very important in learning mathematics because it can facilitate students in facing problems in the lives of students today and in the days to come.

But the reality in the field shows that the problem solving ability is still low. This is in line with research Assesments Program for International Students (PISA) 2015 (Sjøberg, 2015) indicates that student math ability Indonesia ranked at 63 out of 71 countries with a score obtained is 386. Furthermore, the research results Trends in International The 2015 Mathematic and Science Study (TIMSS) shows that ability Indonesian mathematics students ranked 44th out of 49 countries with a score obtained is 397. Thus, it can be known that mathematical abilities Indonesian students are in the low category so that the impact was also wrong one mathematical ability that was a low mathematical problem solving ability (Visser, Juan, & Feza, 2015).

Many factors can affect solving ability mathematical problems, one of which is the positive attitude of students towards mathematics or mathematical disposition. Disposition in a mathematical context relating to how students solve mathematical problems, whether confident, diligent, interested, and thinking flexible to explore various alternative problem solving. Disposition mathematically related to how students ask, answer questions, communicate mathematical ideas, work in groups, and solve math problems. Disposition mathematically according to NCTM (1989) as tendency to think and act positively. In line with NCTM, Sumarmo (2010) argues that mathematical disposition is desire, awareness, tendency and strong dedication to students to think and do things mathematically in a way that is positive.

Kilpatrick, Swafford, & Findell (2001), mathematical disposition is the tendency to view mathematics as something that can be understood, feel mathematics as something useful, believe in diligent effort and resilient in learning mathematics will produce results, do act as an effective learner and the perpetrator of mathematics own. Polking (Hendriana & Sumarmo, 2014), stated that disposition of mathematics shows: (1) confidence in using math, solve problems, give reasons and communicate idea; 2) flexibility in investigating

mathematical ideas and trying to find alternative in solving problem; (3) diligently working on the task mathematics; (4) interest, curiosity, and inner meeting power do math assignments; (5) tend to monitor, reflect their performance and reasoning own; (6) assess the application of mathematics to other situations in mathematics and daily experience; (7) appreciation the role of mathematics in culture and value, mathematics as a tool, and as a language. Based on explanation of mathematical dispositions at above, it can be concluded that mathematical disposition is a tendency strong for students to get carry out various activities mathematics so that it can complete mathematical problems effectively and efficient.

In addition to mathematical dispositions, factors that can influence the ability to solve mathematical problems are learning motivation. This is in line with the opinion of Rakhmat (2007) "One of the factors that influence problem solving is motivation". This means that motivation greatly affects the problem solving process. In solving mathematical problems, learning motivation is important elements that must be possessed by students, students who have high learning motivation will be diligent in doing tasks, resilient and never give up in solving various problems and obstacles, interested in the learning process, thinking about solving problems especially those related to mathematical problems.

From the opinions above, it can be concluded that learning motivation was thought to improve problem solving abilities. This the authors suspect because of the sliced characteristics (indicators) between learning motivation with the characteristics of problem solving. Increasing motivation in solving problems can be through increasing learning motivation and increasing motivation will produce accuracy in problem solving. According to Uno (2010) learning motivation indicators can be classified as the following: (a) successful desires and desires; (b) encouragement and needs in study; (c) future hopes and ideals; (d) deep awards learn; (e) interesting activities in learning; and (f) a conducive learning environment, allowing students to learn with well.

Based on the description above, we can pay attention to the relationship between motivation and mathematical disposition towards problem solving abilities, but this needs to be studied through a study. Therefore, the purpose of this research were to find out and examine the correlation of mathematical disposition motivation and learning motivation on problem solving abilities of yunior students.

2. METHOD

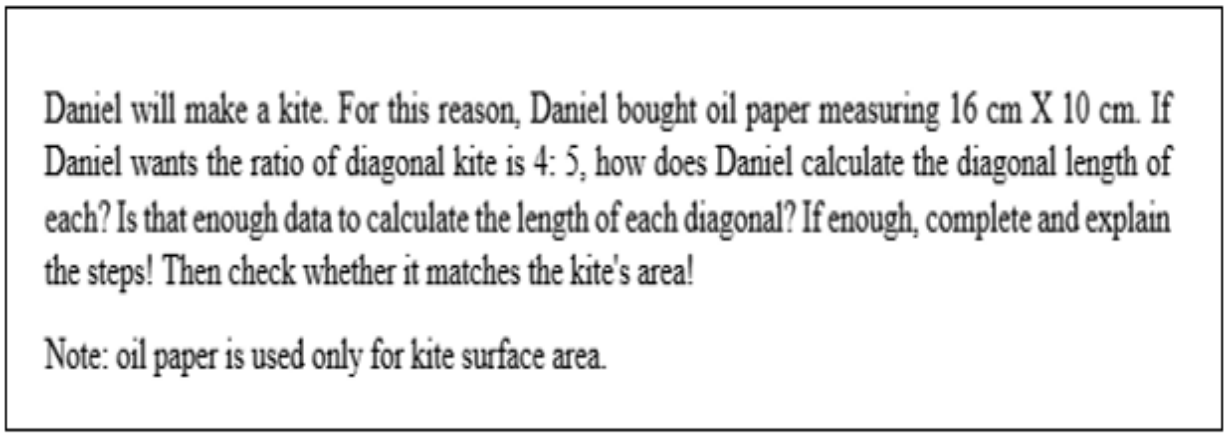
This study uses correlational quantitative methods. This study includes two independent variables namely mathematical disposition and learning motivation. And one dependent variable is students'problem solving abilities. The independent variable in this study was mathematical disposition and learning motivation, while the dependent variable was problem solving ability. The population of this research all students VII grade at SMPN 2 Cimahi, to obtain a representative sample the sample been randomly derived class VII-2 at SMP 2 Cimahi as many as 34 students.

The data collection for each student was given 2 pieces of study instruments, namely problem solving test instruments and non-test questionnaires in a set of mathematical dispositions and learning motivation. The problem solving ability instrument in a set of 5 description questions, while the learning motivation questionnaire in a set of 42 statements with 21 positive questions and 21 negative questions and mathematical disposition questionnaire in a set of 44 statements with 22 positive questions and 22 negative questions. Data obtained from the questionnaire in the form of ordinal data, is changed by using Method Successive Interval (MSI), to become interval data.

Data analysis is quantitative or statistical by using a correlation test that aims to see whether or not there is a relationship between variables. Data was collected then processed using multiple linear regression tests and correlation tests, but before the requirements test was carried out as fulfillment of the assumptions needed in multiple regression analysis on things that are very important in practical terms. Because the data obtained from tests of problem-solving abilities and questionnaires from disposition and learning motivation have become interval data then test requirements referred to are test (1) normality for the dependent variable, and error, (2) test linearity requirements, (3) multicollinearity requirements test, (4) heteroscedasticity requirements test.

Based on the method described above, this study uses multiple regression analysis, and various requirements tests including matching tuna tests were also carried out before further analysis. Further analysis is carried out by applying multiple regression equations $\hat{Y} = b_o + b_1X_1 + b_2X_2$ which is harmonized with research data with various requirements that theoretically have been described in on.

The instrument is given in the form of test and non-test, test of problem solving ability, with the indicator identifying the adequacy of the data for trouble shooting, make a mathematical model of situations or everyday problems and complete it, select and implement strategies to solve in mathematic and or outside mathematic, explain or interpret the results according to the origin problem, and the truth of the results or answers. In Figure 1, Table 1 and Table 2 one of the test and non-test instruments (attitude scale) will be presented with mathematical dispositions and learning motivation used in this research:


Daniel will make a kite. For this reason, Daniel bought oil paper measuring 16 cm X 10 cm. If Daniel wants the ratio of diagonal kite is 4: 5, how does Daniel calculate the diagonal length of each? Is that enough data to calculate the length of each diagonal? If enough, complete and explain the steps! Then check whether it matches the kite's area!

Note: oil paper is used only for kite surface area.

Figure 1. One of test instrument for problem solving abilities used in research

The following in Table 1 presents number of non-test statements mathematical disposition used in research:

Table 1. Instrument lattices of mathematical disposition questionnaire

Indicator	Statement	Responses			
Degree of belief overcomes learning difficulties		**SA**	**A**	**DA**	**SDA**
Confidence	I feel able to completematerial mathematics assignments around and square area. (+)				
Flexible and try various alternatives in solving problems	I feel happy to solve the circumference and square area problems in various different ways. (+)				

Indicator	Statement	Responses			
Degree of belief overcomes learning difficulties		**SA**	**A**	**DA**	**SDA**
Diligently working on mathematical tasks	I study mathematics, when I want to take an exam. (-)				
Interest and curiosity	I am afraid to ask the teacher about the material around and the square area that I have not mastered (-)				
Monitor and reflect on performance / learning mathematics	During learning I think a lot of other things and don't really listen to what is being discussed in class. (-)				
Assess math applications	I study mathematics around and around quadrilateral, useful in solving problems in everyday life. (+)				
Award for the role of mathematics	The math lesson is not difficult, provided we diligently study it. (+)				

Description: SA: Strongly Agree A: Agree DA: Disagree SDA: Strongly Disagree

The following in Table 2 presents a number of non-test statements motivation to learn are used in research:

Table 2. Instrument lattices of learning motivation questionnaire

Indicator	Statement	Response			
Degree of belief overcomes learning difficulties		**SA**	**A**	**DS**	**SDA**
The desire and desire succeed	I se and completing mathematical tasks circumference and area of quadrilateral material. (+)				
	I always give up when faced with a difficult problem . (-)				
There is encouragement and need for learning.	I always study the material to be learned in class (+) first				
	I never forget the lesson the teacher has conveyed (-)				
There are hopes or aspirations for the future	I feel learning material around and the width of a triangle is useful in everyday life. (+)				
There is appreciation in learning.	I always get low scores on material around the area and square area. (-)				
There are interesting activities in learning	At the time of learning I always keep quiet and copy answers from friends. (-)				
The existence of a conducive learning environment, allowing students to learn well.	I studied in a clean and comfortable classroom. (+)				

Description: SA: Strongly Agree A: Agree DA: Disagree SDA: Strongly Disagree

3. RESULTS AND DISCUSSION

Based on the research results, obtained recapitulation of the achievements of students problem solving ability presented in Table 3.

Table 3. Recapitulation of the average achievement of problem solving ability

Problem Solving Indicator	Average (%)	Category
Identify the adequacy of data for problem solving.	65	Enough
Make a mathematical model of everyday situations or problems and solve them	47	Less
Choose and apply strategies to solve mathematical problems and / or outside mathematics	36	Less
Explain or interpret the results according to the origin problem, as well as the truth of the results or answers.	57	Enough

The problem solving instrument consists of 5 questions with 4 problem solving indicators. Based on Table 3, the average student can master the completion of the indicator identifying the adequacy of the data for problem solving. 65 % and is the indicator that has the biggest presentation among other indicators. But students still lack the mastery of indicators making mathematical models of everyday situations or problems and completing them also on indicators choosing and applying strategies to solve mathematical problems and / or outside mathematics, with a percentage of 47% and 57%. In addition, 57 % of the indicators explained or interpreted the results according to the original problem and the correct results or answers were sufficiently mastered by the students.

The following is presented a table of mathematical disposition results questionnaires with a total of 44 statements consisting of 22 positive statements and 22 negative statements. The results of the learning motivation questionnaire with a total of 42 statements consisting of 21 positive statements and 21 negative statements are as follows (Table 4).

Table 4. Results of mathematical disposition and learning motivation questionnaire

Aspect	Category	Total score	Average (%)
Mathematical disposition	Positive Statement	1833	59.13
	Negative Statement	1599	51.58
Motivation Learning	Positive Statement	1795	56.09
	Negative Statement	1561	48.78

Table 4 show that mathematical dispositions of sample presentations in answering positive and negative questions, greater presentation of positive questions which is equal to 59.13 % while presentation of the negative questions is 51.58 % from the explanation above, meaning students already have mathematical dispositions although very little difference with students who not yet have a mathematical disposition .

Furthermore, for the motivation to learn sample presentation in answering positive and negative questions, a greater positive question presentation is equal to 56.09 % while the negative question presentation is 48.78 % from the explanation above, which means that students already have motivation to learn even though there are very few differences with students who do not have learning motivation.

After testing various requirements including the match test, further analysis is carried out by applying the multiple regression equation. If the regression will be done by applying multiple regression equations, namely: $\hat{Y} = b_o + b_1X_1 + b_2X_2$. Here are presented in Table 5, the recapitulation of multiple regression test using SPSS.

Table 5. Recapitulation of the results of multiple regression tests between mathematical dispositions and learning motivation with problem solving abilities

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	51.169	2	25.584	31.298	0.000 [b]
	Residual	23.706	29	0.817		
	Total	74.875	31			

a. Dependent Variable: Score_PM

b. Predictors: (Constant), Motivation Score, Disposing_ Score

Based on Table 5, obtained by the Sig = 0.000 (<0.05), it can be concluded there are significant mathematical disposition and motivation to learn about problem solving abilities signifikan. A calculation is provided to determine the regression equation (Table 6).

Table 6. Multiple regression equation

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.950	2017		0.967	0.342
	Disposal_ score	0.121	0.35	0.751	3.481	0.002
	Motivation Score	0.15	0.037	0.86	0.397	0.694

a. Dependent Variable: Score_PM

Based on Table 6, the obtained constant value is 1.95 while the regression coefficient efficient value is 0.121 for mathematical dispositions and 0.015 for learning motivation, so the double regression equation can be made, namely: $\hat{Y} = 1.95 + 0.121\ X_1 + 0.015X_2$, coefficient values are both positive motivation and disposition can be interpreted that the motive a mathematical disposition of the study and a positive influence on solving mathematical ability. To analyze how closely the relationship between mathematical disposition and learning motivation towards problem solving skills , the pearson correlation coefficient values will be determined as shown in Table 7.

Table 7. Correlation between mathematical dispositions and motivation to learn with problem solving skills

		Motivation Score	Disposal_ score	_PM score
Motivation Score	Pearson Correlation	1	0.875 **	0.742 **
	Sig. (2-tailed)		0.000	0.000
	N	32	32	32
Disposal_ score	Pearson Correlation	0.875 **	1	0.826 **
	Sig. (2-tailed)	0.000		0.000
	N	32	32	32
_PM score	Pearson Correlation	0.742 **	0.826 **	1
	Sig. (2-tailed)	0.000	0.000	
	N	32	32	32

**. Correlation is significant at 0.01 level (2-tailed).

Based on Table 7, Pearson correlation coefficients were obtained between mathematical dispositions and problem solving abilities namely 0.875 and Pearson correlation coefficients betweenmotivation to learn and problem solving abilities, namely 0.742 this shows that the relationship between mathematical disposition and learning motivation with problem solving abilities is in a very strong classification. Positive correlation coefficient shows that between mathematical disposition and learning motivation with problem solving abilities have a positive relationship, meaning that the higher the mathematical disposition and motivation to learn , the greater the ability to solve problems. Next to see the correlation between mathematical disposition and motivation to learn together with problem solving skills can be seen in Table 8.

Table 8. Correlation between mathematical dispositions and motivation to learn together with problem solving skills

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.827 [a]	0.683	0.662	0.904

a. Predictors: (Constant), Score_Disposition, Score_Motivation

Based on Table 8, the correlation coefficient between mathematical disposition and learning motivation together with problem solving ability is 0.827, meaning that the higher the mathematical disposition and motivation to learn , the greater the ability to solve problems. In Table 8 it can also be seen that the determination value of the correlation coefficient is 68.3 %, this can be interpreted that the mathematical disposition and motivation to learn together affect the problem solving ability by 68.3% while the remaining 31.7% is influenced by factors other than mathematical disposition and learning motivation.

Based on the results of data analysis it was concluded that mathematical disposition and student learning motivation had a significant influence on problem solving abilities, it could see from the double regression equation: $\hat{Y} = 1.95 + 0.121\,X_1 + 0.015X_2$. This is in line with the research of Darmawati (2017), Fadila, Septiana, Amelia, & Wahyuni (2019), Kusmaryono, Suyitno, Dwijanto, & Dwidayati (2019) and Taiyeb & Mukhlisa (2015), that there were a relationship between mathematical disposition, learning motivation and learning outcomes. Likewise, it is also in line with the research of Huda (2016) and Ningsih & Rohana (2016) that mathematical dispositions and student learning motivation are mainly students' activeness in aspects: working together to solve problems,

giving opinions when there are group friends who have not understood, resolved dissent, and communicated with friends and teachers during the learning process in the classroom has increased. Therefore teachers need to instill students' learning motivation in each lesson (Suprihatin, 2015). To embed a mathematical disposition and students' motivation is high, then the teacher needs to create a fun learning environment, enable and develop self-confidence and always provide good motivation (Hidayat & Sariningsih, 2018; Subaidi, 2016). According to Cleopatra (2015) and Rosyana, Afrilianto, & Senjayawati (2018), learning in a structured and meaningful manner can also increase learning motivation. With high confidence and motivation, the students' ability to convey ideas or mathematical ideas will be better.

4. CONCLUSION

Based on the results and discussion, the conclusion of this study is that problem solving abilities are influenced by mathematical dispositions and learning motivation. As well as mathematical disposition and learning motivation both individually and jointly have a positive effect on students' problem solving abilities, meaning that the higher the mathematical disposition and learning motivationstudents, the higher the problem solving ability of students, the further the correlation coefficient is classified into a very strong classification. Based on the results of this study also, the authors recommend that the level of problem solving abilities of students is influenced by mathematical disposition factors and learning motivation, so as to improve mathematical disposition and motivation to learn students also need to pay attention to learning that must be designed as well as possible.

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