The effect of self-efficacy and learning motivation on students' mathematical problem-solving ability

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Abstract
The aims of this study are to find out whether there is a significant effect of self-efficacy on mathematical problem-solving abilities. Knowing whether there is a significant effect of learning motivation on students' mathematical problem solving abilities. Knowing whether there is a significant effect of self efficacy and learning motivation on students' mathematical problem solving abilities. This study uses a quantitative approach and the type of research used is correlational research. The sample used in this study were students of class X IPA MA Tanwiriyyah and the sampling method was using cluster random sampling technique. The data collection techniques are questionnaires and tests. And the data analysis uses linear regression analysis. The results of this study indicate that: there is a significant effect of self efficacy and learning motivation on the mathematical problem solving ability of students in class X IPA MA Tanwiriyyah with an effect of 38.1%.
Keywords: learning motivation; mathematical problem-solving ability; self-efficacy

Abstrak
Tujuan penelitian ini adalah untuk mengetahui apakah terdapat pengaruh yang signifikan efikasi diri terhadap kemampuan pemecahan masalah matematika. Mengetahui apakah terdapat pengaruh yang signifikan motivasi belajar terhadap kemampuan pemecahan masalah matematika siswa. Mengetahui apakah terdapat pengaruh yang signifikan efikasi diri dan motivasi belajar terhadap kemampuan pemecahan masalah matematika siswa. Penelitian ini menggunakan pendekatan kuantitatif dan jenis penelitian yang digunakan adalah penelitian korelasional. Sampel yang digunakan dalam penelitian ini adalah siswa kelas X IPA MA Tanwiriyyah dan metode pengambilan sampel menggunakan teknik cluster random sampling. Teknik pengumpulan data menggunakan angket dan tes. Dan analisis data menggunakan analisis regresi linier. Hasil penelitian ini menunjukkan bahwa terdapat pengaruh yang signifikan self-efficacy dan motivasi belajar terhadap kemampuan pemecahan masalah matematis siswa kelas X IPA MA Tanwiriyyah dengan pengaruh sebesar 38,1%.
Kata kunci: motivasi belajar; kemampuan pemecahan masalah matematis; self-efficacy

Introduction

The general objectives of learning mathematics are formulated in the Minister of National Education Regulation No. 22 of 2006 concerning content standards, namely: 1) Understanding mathematical concepts which include explaining the interrelationships between concepts and applying concepts or algorithms, flexibly, accurately, efficiently, and precisely, in problem solving; 2) Using reasoning on patterns and traits, including performing mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements; 3) Problem solving which includes the ability to understand problems, design mathematical models , complete models and interpret solutions that have been obtained; 4) Communicating ideas with symbols, tables, diagrams, or other media to clarify the situation or problem; 5) Have an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention and interest in learning mathematics, as well as being tenacious and confident in problem solving (Herianto et al., 2021).

The standards for the mathematics learning process that students must have are in accordance with the National Council of Teachers of Mathematics (Harahap, 2018; Pradiarti & Subanji, 2022), namely: 1) Problem Solving ; 2) Reasoning and Proof ; 3) Communication (Communication); 4) Connection (Connection); 5) Representation (Representation). Based on the general objective and standard of the process, it can be seen that problem solving ability is one of the important aspects that must be considered in learning mathematics. It is also mentioned that learning mathematics is related to logic and problem solving (Artika & Karso, 2019; Tristianti, Akbar, & Rahayu, 2021).

Currently, students' mathematical problem solving abilities have decreased because at the beginning of 2020 there was an outbreak known as covid-19. The Covid-19 virus is very easy to spread, contagious and quite deadly, so various countries are trying to suppress the rate of spread of this outbreak. The impact of the emergence of COVID-19 has made many changes to human behavior, where almost all have switched to using technology. All work is done from home, whether employees, entrepreneurs, government and even education, work from home is known as work from home (WFH).

In the field of education, learning that is usually done face-to-face has turned into distance learning known as PJJ. Teachers and students are in their respective homes when learning takes place and interact via the internet. The impact of distance learning on students' mathematical problem solving abilities is mentioned in the research of Apriadi, Elindra, and Harahap (2021) that distance learning has an effect on decreasing students' mathematical problem solving abilities.

The factors that influence students' mathematical problem solving abilities are factors that come from within students and from outside (Ag & Fathani, 2018; Ulfa, Roza, & Maimunah, 2022). Factors that come from within students, namely the physical and

spiritual state or condition of students including self-efficacy (self-confidence) and student motivation (Wahyuningtyas, 2019; Hamid & Afriansyah, 2025).

In 1977, Bandura began to design self-efficacy that can affect human behavior (Bandura, 1999; Disparrilla & Afriansyah, 2022). Based on the theory of self-efficacy , a person's success depends on how deeply his thoughts are interacted with the maximum. Self efficacy is a belief which owned student about ability herself in complete question or problems in lesson so that in the learning process students can follow very well. Self-efficacy makes students choose to do or avoid a job or study activity. Self-efficacy affects the choice of a person's activities or efforts in completing the tasks he faces. Individuals who have low self-efficacy have negative thoughts and perceive task obligations as a burden not a challenge so they will set low goals for themselves (Yusuf, 2011; Afriansyah et al., 2024). A student which have self efficacy so he will motivated to succeed in reach destination learning and could endure when facing something difficulty.

The next influencing factor is learning motivation. Motivation comes from the word motive, which is a condition within the individual that encourages individuals to carry out certain activities, whether consciously or not, to achieve certain goals (Winarni, Anjariah, & Muslimah, 2016; Hendrawan & Hendriana, 2021). Motivation is variable which very important in determination someone's success when To do something. A student with high motivation in learning will tend to be active and try to be involved in these learning activities (Wigfield, Klaudia, & Jenna Cambria, 2011). Learning motivation is a power that moves students to do in learning activities in order to achieve an optimal learning outcome.

Previous research by Jatisunda (2017), the relationship of self-efficacy of junior high school students to mathematical problem-solving abilities, concluded that there was an effect of self-efficacy on mathematical problem-solving abilities. This means that the higher the self-efficacy of students, the higher their mathematical problem-solving abilities. Based on the formulation of the problem described, the objectives of this study are knowing whether there is a significant effect of self efficacy and learning motivation on students' mathematical problem solving abilities? .

Method

This research is included in correlational research . This research was conducted from 28 March to 8 April 2022 at MA Tanwiriyyah. The sampling technique used in this study is a probability sampling technique of cluster random sampling type . Respondents in this study amounted to 25 respondents who were students of class X IPA. The variables in this study consisted of two independent variables, namely self-efficacy (X1) and learning motivation (X2), and one dependent variable, namely students' mathematical problem-solving abilities (Y). The method used to obtain data from these variables, namely using the questionnaire method and the test method. The questionnaire method was used to obtain data on

students' self-efficacy and learning motivation, while the test method was used to obtain data on students' mathematical problem solving abilities.

Furthermore, the data were analyzed using a simple linear regression test and multiple linear tests with the help of SPSS. Simple linear regression test to determine the effect of self-efficacy on students' mathematical problem-solving abilities and the effect of learning motivation on students' mathematical problem-solving abilities. Multiple linear regression test was conducted to determine the effect of self-efficacy and learning motivation on students' mathematical problem-solving abilities.

There are two types of data analysis used, namely prerequisite tests and hypothesis testing. Before testing the hypothesis, the prerequisite tests were carried out, namely normality test, linearity test, and classical assumption test. There are several classical assumption tests, namely multicollinearity test, autocorrelation test, heteroscedasticity test. After the prerequisite test is done, the hypothesis is tested including multiple linear regression test.

Result

After the data is collected, namely self-efficacy scores, learning motivation scores, and students' mathematical problem-solving abilities, then the above data is processed and analyzed using simple linear regression analysis and multiple regression analysis. Before using this analytical technique, it must meet the prerequisite tests. The prerequisite tests that must be met are normality test, linearity test, and free from classical assumptions which include multicollinearity, autocorrelation, and heteroscedasticity.

The data on each variable to be analyzed must be normally distributed, therefore it is necessary to test the normality of the data. The test was carried out using the Kolmogorov Smirnov technique. The results of the normality test are presented in Table 1 as follows.

Table 1. Data normality test (one-sample kolmogorov-smirnov test)

		Self efficacy (X1)	Learning motivation (X2)	Mathematics troubleshooting ability
N		25	25	25
Normal Parameters [a,b]	mean	310.4	40.88	32.84
	Std. Deviation	4,439	5,191	9.168
Most Extreme Differences	Absolute	0.144	0.149	0.115
	Positive	0.144	0.076	0.079
	negative	-0.108	-0.149	-0.115
Test Statistics		0.144	0.149	0.115
asymp. Sig. (2-tailed)		0.196 [c]	0.156 [c]	0.200 [c,d]

Based on Table 1, a significance value of 0.200 is obtained. Because the significance value is 0.200 > 0.05, then H_0 is accepted. So it can be concluded that the data is normally distributed.

The results of the linearity test of students' mathematical problem solving abilities with self efficacy are presented in Table 2 as follows:

Table 2. Y Linearity Test with X_1

			Sum of Squares	df	Mean Square	F	Sig.
Mathematics troubleshooting ability * Self efficacy (X1)	Between Groups	(Combined)	1027.443	10	102.744	1.453	0.254
		linearity	409.635	1	409.635	5.793	0.030
		Deviation from Linearity	617.809	9	68.645	0.971	0.501
	Within Groups		989.917	14	70.708		
	Total		2017.360	24			

Based on Table 2, the significance value indicated by Deviation from Linearity is 0.501. Because the significance value is > 0.05, then H_0 is accepted. So it can be concluded that there is a linear relationship between students' mathematical problem solving abilities and self efficacy .

The results of the linearity test of mathematical problem solving abilities with learning motivation are presented in Table 3 as follows.

Table 3. Y Linearity Test with X_2

			Sum of Squares	Df	Mean Square	F	Sig.
Mathematic problem solving ability * Learning motivation (X2)	Between Groups	(Combined)	1213,693	12	101.141	1,510	0.243
		linearity	691,140	1	691,140	10,320	0.007
		Deviation from Linearity	522.553	11	47,505	0.709	0.712
	Within Groups		803.667	12	66,972		
	Total		2017,360	24			

Based on Table 3, the significance value indicated by Deviation from Linearity is 0.712. Because the significance value is > 0.05, then H_0 is accepted. So it can be concluded that there is a linear relationship between mathematical problem solving ability and learning motivation.

In multiple linear regression analysis, it is expected that all independent variables are free from multicollinearity. If the VIF value is not more than 10, then the data is free from multicollinearity. The results of the multicollinearity test are presented in Table 4 as follows.

Table 4. Multicollinearity Test X_1 and X_2 against Y

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-16,098	13,464		-1.196	0.245		
	Self efficacy (X1)	0.461	0.393	0.223	1.173	0.253	0.775	1,290
	Learning motivation (X2)	0.847	0.336	0.479	2,517	0.020	0.775	1,290

Based on Table 4, the VIF value on self-efficacy and learning motivation is 1.290. Because the VIF value is less than 10, it can be concluded that there is no multicollinearity in the two independent variables.

The autocorrelation test aims to see whether in the linear regression model there is a correlation between the confounding error in period t and the confounding error in the previous period. Regression analysis can be done well if there is no autocorrelation. The results of the autocorrelation test are presented in Table 5 as follows.

Table 5. Autocorrelation Test X_1 and X_2 against Y

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.617 [a]	0.381	0.325	7.532	1.688

Based on Table 5, the Durbin-Watson (d) value is 1.688. While the values of dU and dL can be seen in the Durbin-Watson table (attached) with (k , n) for k the number of independent variables (independent) and n the number of samples. The values for dU and dL for k = 2 and n = 25 are dU = 1.5495 dL = 1.2063. Because the value of d lies between dU and (4 – dU) or can be written 1.5495 < 1.688 < 2.4506, it can be concluded that there is no autocorrelation.

Linear regression analysis can be carried out when there is no heteroscedasticity. The results of the heteroscedasticity test are presented in Table 6 as follows.

Table 6 . Heteroscedasticity Test of X_1 and X_2 against Y

			Self efficacy (X1)	Learning motivation (X2)	Unstandardized Residual
Spearman's rho	Self efficacy (X1)	Correlation Coefficient	1.000	0.574 **	-0.008
		Sig. (2-tailed)	0.000	0.003	0.969
		N	25	25	25
	Learning motivation (X2)	Correlation Coefficient	0.574 **	1.000	0.002
		Sig. (2-tailed)	0.003	.	0.993
		N	25	25	25

			Self efficacy (X1)	Learning motivation (X2)	Unstandardized Residual
	Unstandardized Residual	Correlation Coefficient	-0.008	0.002	1.000
		Sig. (2-tailed)	0.969	0.993	0.000
		N	25	25	25

Based on Table 7, the significance value of the two self-efficacy and learning motivation variables is > 0.05, so it can be concluded that there is no heteroscedasticity.

From all the prerequisite tests above, it can be concluded that these data are normal data and free from classical assumptions. So that regression analysis can be done to test the research hypotheses that have been formulated.

The hypothesis for the variable self efficacy (X_1) and learning motivation (X_2) simultaneously on the variable Y is as follows.

H_0 = There is no significant effect of self efficacy and learning motivation on mathematical problem solving abilities,

Ha = There is a significant effect of self efficacy and learning motivation on mathematical problem solving abilities.

The results of the analysis of the hypothesis testing above can be seen in Table 7 below.

Table 7. Multiple Linear Regression Analysis to See the Effect of X_1 and X_2 against Y

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	769.183	2	384.591	6.779	0.005 [b]
	Residual	1248.177	22	56.735		
	Total	2017.360	24			

Based on Table 7, the $_{\text{calculated F value}}$ = 6.779. While the value of F_{table} with df_{reg} = 2 and df_{res} = 22 for a significance level (a) of 0.05 is 3.44. Because the $_{\text{calculated F value}}$ (6.779) > F_{table} (3.44) and the Sig value is 0.005 <0.05, then H_0 is rejected. So it can be concluded that there is a significant effect of self-efficacy on learning motivation on students' mathematical problem solving abilities.

Furthermore, the regression equation model of self efficacy and learning motivation on students' mathematical problem solving abilities is presented in Table 8 as follows.

Table 8. Multiple Linear Regression Analysis to See Regression Equations Effect of X_1 and X_2 against Y

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-16.098	13.464		-1.196	0.245		
	Self efficacy (X1)	0.461	0.393	0.223	1.173	0.253	0.775	1.290
	Learning motivation (X2)	0.847	0.336	0.479	2.517	0.020	0.775	1.290

Based on Table 8, it can be seen that the constant value is -16.098, the self-efficacy coefficient is 0.461 , and the learning motivation coefficient is 0.847, so that the regression equation is obtained as follows.

$$Y = a + b_1 X_1 + b_2 X_2$$

$$Y = -16{,}098 + 0.461\, X_1 + 0.847\, X_2$$

The multiple linear regression equation above can be explained as follows.

a) a is a constant with a magnitude of -16,098 and a negative value stating that if the independent variable (self efficacy and learning motivation) decreases by 1 unit, then the dependent variable (mathematical problem solving ability) will also decrease by -16,098 units.

b) b1 is the regression coefficient of $_{self}$-efficacy (X1) which is 0.461 which means that each addition of the self-efficacy variable (X1 $_{)\ is\ 1}$ unit, it will increase the amount of mathematical problem-solving ability (Y) by 0.461 units.

c) b_2 is the regression coefficient of learning motivation (X_2) which is 0.847 which means that each additional motivation variable (X_2) is 1 unit, it will increase the amount of mathematical problem solving ability (Y) by 0.847 units.

The value of the coefficient of determination (R_2) is 0.381, which implies that the effect of self-efficacy (X_1)and learning motivation (X_2) on mathematical problem solving ability is 38.1%, while the remaining 61.9 % influenced by other variables.

Discussion

Based on data analysis, it is known that there is an influence of self-efficacy and learning motivation on students' mathematical problem solving abilities. This is indicated by the calculated $F_{value} = 6.779 > F_{table} = 3.44$ with a significance level of 5%. With an effect of as large as indicated by the value of R square = 0.381, and the regression equation $Y = -16{,}098 + 0.461\, X_1 + 0.847\, X_2$. The results of this study indicate that self - efficacy and learning motivation affect students ' mathematical problem solving abilities .

Problem solving is a process to overcome the difficulties encountered to achieve the expected goals (Sumartini, 2016; Adipat et al., 2021). Mathematical problem solving is a process in solving unusual problems in mathematics, which requires high thinking in

solving the problem, but the problem is still affordable for students' thinking (Muhalizah, 2019; Ida, Aziz, & Irawan, 2021). Factors that come from within students, namely the physical and spiritual state or condition of students including self-efficacy (self-confidence) and student motivation to learn (Wahyuningtyas, 2019; Sahril, Vega, & Muhammad, 2022).

Self-efficacy makes students choose to do or avoid a job or study activity. Self-efficacy affects the choice of a person's activities or efforts in completing the tasks he faces (Nugrahani, 2013; Altarawneh et al., 2023). So that students with low self-efficacy will avoid tasks and feel unable to achieve success with their own abilities, while students with high self-efficacy will try hard and believe in their abilities to achieve success.

Learning motivation is a driving force or energy that comes from within a person to carry out learning activities and provide direction to learning activities in order to achieve a goal (Jecseneri, 2018; Tohir, 2022). Students who have motivation will have a strong desire to achieve goals until they achieve the desired success.

Conclusion

Based on the data analysis and discussion that has been carried out, the following decisions can be made. There is a significant effect of self efficacy and learning motivation on students' mathematical problem solving abilities.

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Conflict of Interest

The authors declare that no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely by the authors.

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