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The Influence of Independence and Mathematical Communication Skills on Student Learning Outcomes in the Material of Relations and Functions

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Abstract: The independent and communication skills in mathematics learning are two very important competency components that students must master and greatly influence student learning outcomes. However, students at SMPN 4 Mataram have relatively low independence and mathematical communication skills. As a result, student learning outcomes obtained by more than 50% are classically below the KKM. Therefore, this research focuses on two variables that influence learning outcomes, namely independence and mathematical communication skills. This research uses quantitative methods. The population was 125 class VIII students. Using Simple Random Sampling, a sample of 32 students was obtained. Data on class VIII students at SMPN 4 Mataram for the 2023/2024 academic year was collected using questionnaires and tests. By using regression analysis the results obtained were 1) There was an influence of independence on student learning outcomes in relation and function material of 25,4%; 2) There is an influence of mathematical communication skills on learning outcomes V of 43,8%. 3) There is an influence of independence and mathematical communication skills together on student learning outcomes in relation and function material of 72,4%.

Keywords: Independent, Mathematics Communication Skills, Student Learning Outcomes

Introduction

Mathematics is wrong One subjects that are mandatory at every level of education, from elementary school to high school (Wahyi, Turmuzi, Tyaningsih, & Azmi, 2023). Mathematics subjects have abstract material. The abstractness of mathematics requires appropriate approaches, because its abstractness also causes many students to experience difficulties (Soviawati, 2011). Students who experience learning difficulties will have an impact on low learning outcomes (Arviana, Syahrilfuddin, & Antosa, 2020). The high and low levels of student learning outcomes can be seen from students' achievement of the KKM standards determined by the school. (Yulianingsih, & Sobandi, 2017).

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The results of the preliminary study on May 9 2023 showed that the learning outcomes of class VIII students at SMPN 4 Mataram were still low, seen from the KKM set by the school in mathematics, namely 75. Based on Mid-Semester Assessment (PTS) data for class VIII students for the odd semester of the 2022 academic year /2023, it can be seen that as many as 124 students (97%) out of 128 students got scores below the KKM, while only 4 students (3%) got scores above the KKM.

Learning outcomes are a benchmark used to determine the level of student success in knowing and understanding a subject which is usually expressed in grades in the form of letters or numbers (Sripatmi, Baidowi, & Fitriani, 2019). According to Sobri (2020) there are three factors that influence student learning outcomes, including internal factors, external factors and learning approach factors. Internal factors include self-confidence, learning independence, motivation, creative thinking ability, critical thinking ability, and so on (Sarjana, Turmuzi, Tyaningsih, Lu'luilmaknun, & Kurniawan, 2022). One of the internal factors involving psychological aspects is independence. Independence comes from the word independent which means standing alone, namely a condition that allows a person to regulate and direct themselves according to their level of development (Kurniawan, 2022). Independence is the ability where students can control their behavior and can organize and evaluate their own learning as an effort to achieve learning goals (Baidowi, Sarjana, Novitasari, & Kurniawan, 2021).

The indicators for learning independence according to Baidowi. et al (2021) include (1) Controlling behavior, namely students choose, create structures, and create an environment that optimizes their learning. (2) Managing learning, namely students arranging, planning, making plans before studying and setting their own learning goals (3) Evaluating learning, namely where the results achieved are not satisfactory, students will try to improve or re-fine their learning activities.

Based on the results of an interview on May 9 2023 with one of the class teachers, information was obtained that during the learning process, less than students from all classes studied the material first before entering class. This shows that not all class students have independence seen from indicator number two, namely students make plans before studying. In line with what was written by Riyanti, Wahyudi and Suhartono (2021) that independent students will prepare the material they have studied or repeat the material they have studied. The results of observations on May 9 2023 showed that only one student in one class did the assignment, and even then the assignment was directly copy-paste from the Internet. This indicates that students do not yet have independence based on the first indicator, namely optimizing their learning, where students have not fully tried to find their own answers in learning.

Furthermore, according to Rahmalia, Hajidin and Ansari (2020), one of the internal factors in other psychological aspects that can influence student learning outcomes is mathematical communication skills. Understanding mathematical communication skills according to Turmuzi, Wahidaturrahmi and Kurniawan (2021) mathematical communication skills are a very important activity in everyday life, where in communication the activity of conveying information, be it messages, inspiration or ideas, from one party to another. According to Hodiyanto (2017) mathematical communication skills consist of oral communication and written communication. Oral communication such as: discussing and explaining. Written communication such as expressing mathematical ideas through pictures/graphs, tables, equations, or in the students' own language. Therefore, this research uses written mathematical communication skills because they are easier to measure and more effective to apply.

Damayanti, Zulkarnain and Asri (2022) detail the indicators of mathematical communication skills as follows: 1) Writing, namely writing down and explaining mathematical ideas logically and mathematically. 2) Drawing, namely stating the problem in the form of a picture or table clearly and precisely. 3) Mathematical expressions, namely using mathematical terms and symbols correctly. Based on an interview on May 9 2023 with one of the class VIII teachers, information was obtained that students had difficulty identifying the information known in the questions and also still had difficulty creating mathematical models. It can be seen that students do not have the mathematical communication skills of class VIII students as seen from the third indicator, namely students are able

to use mathematical terms and symbols correctly. The results of observations on May 9 2023 carried out in class 2 showed that students were not very precise in drawing points on the coordinate plane. This indicates that students do not yet have mathematical communication skills based on the second indicator, namely drawing.

Based on the description above, it is important to carry out research to determine the relationship and influence of independence and mathematical communication skills which are thought to be caused by low learning outcomes. This research aims to find out how independence and mathematical communication skills influence student learning outcomes in class VIII relationship and function material at SMPN 4 Mataram for the 2023/2024 academic year.

State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Method

This research uses a quantitative approach to this type of research after the fact. The aim of the researcher using a quantitative approach is to test the proposed hypotheses. This research was conducted at SMPN 4 Mataram in the odd semester of the 2023/2024 academic year. The population in this study were all class VIII students at SMPN 4 Mataram, totaling 125 students spread across 4 classes. With the selected research sample, namely class VIII-4, there were 32 students with a sampling technique, namely Probability Sampling,

The data collection techniques used to obtain data in this research were questionnaires and tests. A questionnaire containing 19 statements was used to obtain data regarding independence. Meanwhile, the 2-number description test was used to obtain data on mathematical communication skills on Straight Line Equations material and learning outcomes on Relations and Functions material. Before being used for research, a content validity test was carried out on all instruments. Content validity testing is based on Aiken validity. This test is based on the results of the validator's assessment of an item in terms of the extent to which the item represents something to be measured.

After the data is declared valid, an inferential analysis test will be carried out. Inferential analysis tests include analysis prerequisite tests (normality test, homogeneity test and multicollinearity test) as well as hypothesis tests (t test, f test, simple regression test, multiple regression test, partial determination test and determination test simultaneous).

Result and Discussion

Inferential Statistical Analysis
Inferential statistical tests using SPSS.
Prerequisite Test Result
Normality Test

Table 1. Normality Test Result

Asymp. Sig. (2-tailed)	α	Conclusion
0,200	0,05	$0{,}200 > 0{,}05$ (Normally Distributed)

Homogeneity Test

Table 2. Result of The Homogeneity of Independent Test With Learning Outcomes

Sig.	α	Conclusion
0,064	0,05	$0{,}064 > 0{,}05$ (Homogen)

Table 3. Homogeneity Test Results Mathematical communication abilities with learning outcomes

Sig.	α	Conclusion
0,190	0,05	$0{,}190 > 0{,}05$ (Homogen)

Multicollinearity Test

Table 4. Multicollinearity test results of independent variables and mathematical communication skills

		Conclusion
VIF	1,022	$1{,}022 < 10$ (Multicollinearity does not occur)
Tolerance	0,978	$0{,}978 > 0{,}1$ (Multicollinearity does not occur)

Based on the results of the prerequisite tests above, it was concluded that the independence data, mathematical communication ability data and learning outcome data obtained were normally distributed and had homogeneous variances so that they could be continued with parametric analysis. Furthermore, there is no multicollinearity between the independence variable and the mathematical communication ability variable so that it can be continued with multiple linear regression analysis.

Hypothesis Test Result

T-test (Partial)

T-Test Of The Independence Variable On Learning Outcomes

The first hypothesis proposed in answering the first objective of this research is as follows.

H_o: There is no influence of independence on student learning outcomes in class VIII relationship and function material at SMPN 4 Mataram for the 2023/2024 academic year.

H_a: There is an influence of independence on student learning outcomes in class VIII relationship and function material at SMPN 4 Mataram for the 2023/2024 academic year.

Decision making rules in the t test at the significance level using the SPSS v.29 program, namely.

H_o rejected if $t_{count} > t_{table}$ or value $Sig < 0{,}05$

H_a accepted if $t_{count} \leq t_{table}$ or value $Sig \geq 0{,}05$

The following are the results of the t test calculation of the independence variable on learning outcomes.

Table 5. Results of the t test of independence variables on learning outcomes

Coefficients[a]					
Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	14.703	13.189		1.115	.274
Independence	.738	.231	.504	3.198	.003

Dependent Variable: Learning Outcomes

Based on Table 5 above, it can be seen that the value $t_{count} = 3{,}198$. Meanwhile, to find out the t_{table}value, you must first determine the degrees of freedom (dk). In this study, there are 2 predictors (k), namely independence and student learning outcomes, the total sample (n) used is 32 students in class VIII-4, so dk = 32 at a significance level of 5%, so that we get t_{table}= 1,697 value. So H_o is rejected because $t_{count} > t_{table}$ (3,198) > 1,697 or$Sig < 0{,}05$ $(0{,}03 < 0{,}05)$. So it can be concluded that there is an influence of independence on student learning outcomes in the material on relations and functions in class VIII SMPN 4 Mataram for the 2023/2024 academic year.

T Test Of The Mathematical Communication Ability Variable On Learning Outcomes

The second hypothesis proposed in answering the second objective of this research is.

H_o: There is no influence of mathematical communication skills on student learning outcomes in relation and function material for class VIII SMPN 4 Mataram for the 2023/2024 academic year.

H_a: There is an influence of mathematical communication skills on student learning outcomes in relation and function material for class VIII SMPN 4 Mataram for the 2023/2024 academic year.

Decision making rules in the t test at the significance level using the SPSS v.29 program.

H_o rejected if $t_{count} > t_{table}$ or value $Sig < 0{,}05$

H_a accepted if $t_{count} \leq t_{table}$ or value $Sig \geq 0{,}05$

The following are the results of the t test calculation of the mathematical communication ability variable on learning outcomes.

Table 6. Results of the t test for the variable Mathematical Communication Ability on Learning Outcomes

Coefficients[a]					
Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	2.142	.362		5.913	<,001
Mathematical Communication Ability	.026	.005	.662	4.840	<,001

a. Dependent Variable: Learning Outcomes

Based on the calculation results shown in Table 6, it shows that $t_{count} > t_{table}$ is 4.840 > 1.697 at a significance level of 5% and the significance value for the mathematical communication ability variable is < 0,001 so that Ho is rejected, meaning that there is an influence of mathematical communication ability on student learning outcomes in the material. relations and functions of class VIII SMPN 4 Mataram for the 2023/2024 academic year.

F-Test (Simultaneous)

Furthermore, the hypothesis proposed in answering the third objective of this research is as follows.

H_o: There is no influence of independence and mathematical communication skills on student learning outcomes in class VIII relationship and function material at SMPN 4 Mataram for the 2023/2024 academic year.

H_a: There is an influence of independence and mathematical communication skills on student learning outcomes in class VIII relationship and function material at SMPN 4 Mataram for the 2023/2024 academic year.

Decision making rules in the f test at the significance level using the SPSS v.29 program:

H_o rejected if $f_{count} > f_{table}$ or value $Sig < 0{,}05$

H_a accepted if $f_{count} \leq f_{table}$ or value $Sig \geq 0{,}05$

The following are the results of the f test calculation of independence variables and mathematical communication skills on learning outcomes.

Based on the Anova table above, it can be seen that the $f_{count} = 37{,}994$. Meanwhile, to see the f table value, you must first determine the degrees of freedom of the numerator (df) and the degree of freedom of the denominator (db). In the entire sample studied (N) with the formula df = m (number of predictors) and $db = N - m - 1$. In this study, there were 2 predictors, namely X_1 and X_2 and the number of samples used was 32 students, so $df = 2$ and $db = 32 - 2 - 1 = 29$ at a significance level of 5%, then the value of $f_{table} = 3{,}33$ is found, then the value of $f_{count} >$

$f_{table} = 37{,}994 > 3{,}33$ is obtained. Then the significance value obtained was $< 0{,}01$, which is smaller than $0{,}05$

So, rejected because or value meaning that there is an influence of independence and mathematical communication skills together on student learning outcomes in the material Relations and Functions for class VIII SMPN 4 Mataram for the 2023/2024 academic year.

Simple Regression Analysis Test

The following are the results of simple regression analysis calculations of the independence variable on mathematics learning outcomes as seen in Table 7 below.

Table 7. Table of Results of Simple Linear Regression Analysis of Independence on Learning Outcomes

Coefficients[a]		
Model	Unstandardized Coefficients	
	B	Std. Error
(Constant)	14.703	13.189
Independence	.738	.231

a. Dependent Variable: Learning Outcomes

Based on Table 7, the constant value for the independence variable is 14,703 and the independence coefficient is 0,738. Thus, a linear regression equation can be created as follows:

$$Y = 14{,}703 + 0{,}738X_1$$

Furthermore, the results of simple regression analysis calculations of mathematical communication abilities on mathematics learning outcomes can be seen in Table 8 below.

Table 8. Results of Simple Linear Regression Analysis of Mathematical Communication Ability on Learning Outcomes

Coefficients[a]			
Model		Unstandardized Coefficients	
		B	Std. Error
1	(Constant)	2.142	.362
	Mathematical Communication Ability	.026	.005

a. Dependent Variable: Learning Outcomes

Based on Table 9, the constant value for the mathematical communication ability variable is 2,142 and the mathematical communication ability coefficient is 0,026. Thus, a linear regression equation can be created as follows

$$Y = 2{,}142 + 0{,}026X_2$$

Multyple Analysis Test

The results of the multiple linear regression analysis calculations can be seen in Table 9 below.

Table 9. Results of Multiple Linear Regression Analysis of Independence and Mathematical Communication Ability on Learning Outcomes

Coefficients[a]			
Model		Unstandardized Coefficients	
		B	Std. Error
1	(Constant)	1.932	9.406

Independence	.425	.205
Mathematical Communication Skills	.533	.133

b. Dependent Variable: Learning Outcomes

Based on Table 9, the constant value obtained is 1,932 with an independence coefficient value (X_1) of 0,425 and a mathematical communication ability coefficient value (X_2) of 0,533. Thus, a linear regression equation can be created as follows.

$$Y = 1{,}932 + 0{,}425X_1 + 0{,}533X_2$$

Determination Test

Partial Determination Test Result

The results of the partial determination test calculation of the independence variable on learning outcomes and the mathematical communication ability variable on learning outcomes can be seen in Table 10 and Table 11 respectively below.

Table 10. Results of the Determination Test of Independence Variables on Learning Outcomes

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.504[a]	.254	.229	10.46228
a. Predictors: (Constant), Independence				

Table 11. Results of the Determination Test of Mathematical Communication Ability Variables on Learning Outcomes

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	$.662a$	.438	.420	.54876
b. Predictors: (Constant), Mathematical Communication Ability				

The determination (R-Squared) of the independence variable on mathematics learning outcomes is 0,254 or 25,4%. This means that the independence variable influences student learning outcomes in mathematics subjects by 25,4% while the remaining 74,6% is influenced by other factors. From these results, it appears that the influence of independence on student learning outcomes is not high enough or is still below 50%.

Then, based on Table 12 above, the coefficient of determination (R-Squared) for the mathematical communication ability variable on learning outcomes is 0,438 or 43,8%. This means that the mathematical communication ability variable influences student learning outcomes in mathematics subjects by 43,8%. Meanwhile, the remaining 56,2% is influenced by other factors. From these results, it can be seen that the influence of mathematical communication skills on student learning outcomes is not high enough, still below 50%.

Simultaneous Determination Test Results

The calculation results of the simultaneous determination test of independence variables and mathematical communication skills on learning outcomes can be seen in Table 12 below.

Table 12. Results of the Coefficient of Determination of Independence and Mathematical Communication Ability on Learning Outcomes

Based on Table 12, the coefficient of determination (Adjusted R Square) value for the variables of independence and mathematical communication skills together influence mathematics learning outcomes by 0,724 or 72,4%, while the remaining 27,6% is influenced by other factors. From these results, it can be seen that the influence of independence and mathematical communication skills on student learning outcomes is quite high, above 50%.

Based on the results of this research, a discussion of the hypothesis will be carried out to answer the objectives of this research, where from the results of these calculations a hypothesis can be accepted or rejected, namely by looking at the t value and the level of significance value.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.851[a]	.724	.705	9.08871

a. Predictors: (Constant), Independence, Communication ability

The Influence of Independence on Student Learning Outcomes

In the t test for the independence variable (X_1) on learning outcomes (Y) The value obtained is $t_{count} > t_{table}$, namely 3,198 > 1,697 at the 5% significance level. Then the significance value for the independence variable is $0{,}003 < 0{,}050$, so it can be concluded that there is an influence of independence on the results student learning on relationship and function material for class VIII SMPN 4 Mataram Teachings 2023/2024. The results of this research are in line with the results of Indah & Farida (2021) with the title "The Effect of Learning Independence on Learning Outcomes Student Mathematics" which shows the results that independence has an influence on learning outcomes.

The regression equation on the independent variable (X_1) on the results study (Y) namely $Y = 14.703 + 0.738X_1$. The positive constant value is 14.703 shows a positive influence for the independent variable independence. Then The coefficient of independence ($X1$) is 0.738, meaning that every time one point is added for independence resulted in an increase of 0.738 points or 73.8% of the results learn it. The influence of independence on mathematics learning outcomes in class VIII students of SMPN 4 Mataram for the 2023/2024 academic year, namely 25,4%, while the remaining 74,6% is influenced by other variables that were not tested in this research.

Based on research that has been conducted, it is true that learning independence is a factor in student learning success, and is so important that it must be of concern to the parties involved in the world of education. Learning independence according to Akbar, Hamid, Bernard and Sugandi (2018) is defined as a manifestation of the attitudes and characteristics of children who have the will to learn on their own without being ordered, learn their own learning needs, have desired learning goals, can regulate their own time and method of learning, do not give up easily. if you experience difficulties and can evaluate the things you have learned. The characteristics of independent learning are very necessary for successful learning in mathematics. This is because to be able to master mathematics well, students have to practice a lot in working on questions and solving problems on their own. The more students practice and solve problems independently, the better the learning outcomes they will obtain.

The Influence of Mathematical Communication Skills on Student Learning Outcomes

Next, for the mathematical communication ability variable ($X2$) towards mathematics learning outcome variable (Y) obtained the value $t_{count} > t_{table}$ on 5% significance level, namely $4{,}840 > 1{,}897$ with a significance value for the variable mathematical communication ability is <0.01, where the sig value is $< 0{,}05$, so it can be concluded that there is an influence on communication skills mathematics on student learning outcomes in class VIII relationship and function material SMPN 4 Mataram 2023/2024 Academic Year. The results of this study are in

line with the results of Zahara's research (2021) with the title "The Influence of Learning Independence and Mathematical Communication Skills on Student Mathematics Learning Outcomes" which shows the results that mathematical communication skills have nfluence on learning outcomes.

The regression equation is for the communication ability variable mathematics (X_2) to learning outcomes (Y), namely $Y = 2{,}142 + 0{,}026X_2$. Mark the positive constant, namely 2.142, indicates a positive influence for the variable independent mathematical communication skills. Then the ability coefficient mathematical communication (X_2) is 0,026, meaning every time one is added points for mathematical communication skills resulted in an increase of points or 2.6% of learning outcomes. The big influence of communication skills mathematics on mathematics learning outcomes for class VIII students at SMPN 4 Mataram for the 2023/2024 Academic Year, namely 43,8%, while the remainder is 56,2%was influenced by other variables not tested in this research.

Mathematical communication skills are very important in learning mathematics. Because through communication, students can organize and consolidate his mathematical thinking. And students can explore ideas the math. In learning mathematics students are required to develop mathematical language and symbols so that students can communicate verbally and in writing, and this will definitely very influential on the results of his mathematics learning, because it is deep Mathematics for learning outcomes is closely related to students' abilities in representing what is known and what has been learned to in linguistic and symbolic mathematics.

The Influence of Independence and Mathematical Communication Skills on Student Learning Outcomes

Next for the independence variable (X_1) and communication skills mathematics (X_2) on the mathematics learning outcome variable (Y) obtained a value $f_{count} > f_{table}$ on the independent variable independence (X_1) and abilities mathematical communication (X_2) on the dependent variable of mathematics learning outcomes (Y) which is $37{,}994 > 3{,}33$ at the 5% significance level and the significance value on the variables of independence and mathematical communication skills of $< 0{,}01$, where the sig value $< 0{,}05$, so it can be concluded that there is an influence independence and mathematical communication skills together on student learning outcomes in relation and function material for class VIII SMPN 4 Mataram Academic Year 2023/2024. The results of this study are contradictory the results of Zahara's research (2021) with the title "The Influence of Learning Independence and Mathematical Communication Skills on Student Mathematics Learning Outcomes" which shows the results of independent learning and communication skills mathematics together has no effect on learning outcomes.

The regression equation is for the independent variable ($X1$) and mathematical communication skills ($X2$) on learning outcomes (Y), namely $Y = 1{,}932 + 0{,}425X_1 + 0{,}553X_2$. Based on the regression equation, it is obtained The positive constant, namely 1.932, indicates a positive influence for the variable independence independence and mathematical communication skills. Then The coefficient of independence (X_1) is 0,425, meaning that every time one point is added for independence resulted in an increase of 0,425 points or 42,5% of results learn it. Then the mathematical communication ability coefficient (X_2) is 0,553, meaning every time one point is added for communication skills Mathematics results in an increase of 0,553 points or 53,3% of learning outcomes. There is a big influence of independence and mathematical communication skills on the results learning mathematics for class VIII students at SMPN 4 Mataram in the academic year 2023/2024, namely 0,724 or 72,4% while the remaining 27,6% is influenced by other factors that were not tested in this study.

The contribution made by the variables independence and communication skills mathematics is considered high considering independence and communication skills Mathematics is one of the internal factors that influences student learning outcomes. Based on

the description above, theoretically and empirically it can be concluded that there is a partial and simultaneous influence of the independence variable and Mathematical communication skills on the learning outcomes of class VIII SMPN students 4 Mataram 2023/2024 Academic Year.

Conclusion

Based on the results of research on class VIII students of SMPN 4 Mataram for the 2023/2024 academic year, it was found that 1) There is an influence of independence on student learning outcomes in class VIII relationship and function material at SMPN 4 Mataram for the 2023/2024 academic year marked by the value $t_{count} > t_{table}(3{,}198 > 1{,}697)$ and the significance value is $0{,}003 < 0{,}05$ with a large contribution of influence of 25,4%. 2) There is an influence of mathematical communication skills on student learning outcomes in class VIII relationship and function material at SMPN 4 Mataram for the 2023/2024 academic year marked by the $t_{count} > t_{table}(4{,}840 > 1{,}697)$ and the significance value is $< 0{,}01$, where the sig value is $< 0{,}05$ with a large influence contribution of 43,8%. 3) There is an influence of independence and mathematical communication skills together on student learning outcomes in class VIII relationship and function material at SMPN 4 Mataram for the 2023/2024 academic year, marked by the value $f_{count} > f_{table}(37{,}994 > 3{,}33)$ and the significance value is $< 0{,}01$, where the sig value is $< 0{,}05$ with a large contribution of influence of 72,4%.

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