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The Effect of Logico-Mathematical Intelligence on the Ability to Solve Mathematical Problems Based on the Minimum Competency Assessment (AKM) of Students

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Abstract

This research aims to know the effect of students' logico-mathematical intelligence on their ability to solve mathematical problems based on the AKM. This research is ex-post facto research. This research was conducted on 31 grade XII MIPA students of SMAN 5 Sinjai in the academic year 2021/2022. The data were collected using students' logico-mathematical intelligence and literacy numeracy tests. The data were analyzed using descriptive and inferential statistics with simple linear regression analysis. The results showed that: (1) students' logico-mathematical intelligence is in the moderate category, (2) students' ability to solve mathematical problems based on AKM is in the moderate category, and (3) students' logico-mathematical intelligence affects students' ability to solve mathematical problems based on AKM.

Keywords: Students' logico-mathematical intelligence; mathematical problem-solving; minimum competency assessment.

INTRODUCTION

The National Examination was implemented in Indonesia from 2005 to 2013 to measure the achievement of students' competence of graduates as a result of the learning process by referring to the Graduate Competency Standards (SKL). In 2014 Indonesia used Computer Based Test (CBT), and in 2021 Ministry of Education, Culture, Research, and Technology implemented a National Assessment.

Kemdikbud (2020) states that the National Assessment policy allows the evaluation and mapping of the education system in the form of inputs, processes, and results instead of evaluating individual student achievement. The results of the National Assessment will then become a mirror to improve the quality of Indonesian education. The Minimum Competency Assessment (AKM), Character Survey, and Learning Environment Survey will be conducted in the National Assessment.

The Minimum Competency Assessment (AKM), according to Kemdikbud (2020: 3), is the first part of the National Assessment which is designed to assess the basic competencies needed by all students to develop their capacity and participate positively in society. The basic competencies measured in the AKM are literacy and numeracy. Nurwati (2021) states that mathematics has an important role in shaping and developing logical, systematic, and critical thinking skills. Numeracy is related to the ability to digest information in the form of numbers or quantitatively. Numeracy is a fundamental ability needed by every individual to analyze numerical information and interpret the results to predict and make further decisions. AKM aims to encourage teachers to develop competencies and logical-systematic thinking of students, thereby increasing students' reasoning abilities and teacher performance.

Gardner (1999) states that the human brain stores at least nine types of intelligence: linguistic intelligence, logical-mathematical intelligence, spatial intelligence, kinesthetic intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, existentialist intelligence, and naturalist intelligence. Kurniawati and Kurniasari (2019) state several bits of intelligence related to mathematical literacy, including linguistic intelligence, logico-mathematical intelligence, and spatial intelligence. Logico-mathematical intelligence is needed in solving mathematical literacy problems. Wherein logico-mathematical intelligence students will be able to understand problems and perform analytical calculations and the ability to reason and abstract. According to Damayanti, Sunardi, and Oktavianingtyas (2017), students with logico-mathematical intelligence fulfill every indicator in the mathematical literacy thought process component. This statement is in line with Ngazizah (2019) that there is a positive and significant influence of logico-mathematical intelligence on the ability to solve PISA-type math problems.

Based on the description above, the author is interested in researching logico-mathematical intelligence and the ability to solve mathematical problems based on AKM. This research aims to know the level of students' logico-mathematical intelligence, the level of students' ability to solve mathematical problems based on the AKM, and whether logico-mathematical intelligence positively affects the ability to solve mathematical problems based on AKM.

METHOD

A. Type of the Research

This is quantitative research employing an ex-post-facto approach.

B. Place and Time of the Research

This research was conducted at SMAN 5 Sinjai in the odd semester of the academic year 2021/2022.

C. Population and Sample of Research

The population used in this study was all students of class XII MIPA SMAN 5 Sinjai, totaling 138 students. The sampling in this study used simple random sampling. The sample size in this study was 22% or as many as 31 students of the total population.

D. Methods

Figure 1. Design of Relationships between Research Variables

Note:

X= logico-mathematical intelligence

Y= the ability to solve mathematical problems based on AKM

There were two stages of research planned by researchers in this study, namely the preparation stage and the research implementation stage. The preparations made before conducting the research were compiling research instruments, validating research instruments with expert lecturers, asking for research permission, and consulting with a mathematics teacher and supervisors. Meanwhile, the implementation stage of the research began with giving directions to the respondents, distributing test sheets, filling out test sheets by respondents, and collecting the results of filling out test sheets; then, the researcher records, analyzes, and interprets the score data obtained by students.

E. Data Collection Techniques and Research Instruments

The data were collected using students' logico-mathematical intelligence and literacy numeracy tests.

Logico-mathematical intelligence test

A logico-mathematical intelligence test is a multiple-choice test with five alternative answers (A, B, C, D, and E) based on indicators of logico-mathematical intelligence variables. Indicators of

logico-mathematical intelligence are logical ability, problem-solving ability, ability to analyze relationship patterns, reasoning ability, and numerical ability.

Numeracy test

This instrument determines students' ability to solve mathematical problems based on AKM related to students' numeracy or mathematical literacy skills. This instrument was in the form of a test consisting of multiple-choice questions, complex multiple-choice, matchmaking, and short entries. The test was prepared based on indicators of the AKM variable by the Ministry of Education, Culture, Research, and Technology Policy. The numeracy test consisted of three aspects: Geometry and Measurement, Algebra, and Data and Uncertainty.

F. Data Analysis Techniques
Descriptive statistical analysis

Descriptive statistical analysis was used to describe each research variable, logico-mathematical intelligence, and ability to solve mathematical problems based on AKM. Research variable data were categorized according to scale intervals according to the guidelines for categorizing variable scores from Riwidikdo (2012).

Inferential statistical analysis

Inferential statistical analysis was carried out with the help of JASP software. Before testing the research hypothesis, the classical assumption test consisted of a normality test, linearity test, and heteroscedasticity test. After the data met the classical assumption test, the data were analyzed with a simple linear regression analysis.

RESULT AND DISCUSSION

A. Result

1. Descriptive Statistical Analysis

The results of a descriptive statistical analysis based on research data obtained using a logico-mathematical intelligence test and numeracy literacy test are presented as follows:

a. Logico-mathematical Intelligence

The number of questions in the student's logico-mathematical intelligence test is as many as 25, which 31 students fill out. The results of the logico-mathematical intelligence data analysis are presented in Table 1.

Table 1. Statistical Description of Logico-mathematical Intelligence Variables

Statistics	Statistical Value
Sample Size	31
Mean	15,161
Median	15
Mode	16
Standard Deviation	2,339
Minimum Score	10
Maximum Score	21

Based on the data on students' logico-mathematical intelligence test scores, the average score of students' logico-mathematical intelligence was 15,161 of the ideal score of 25, which might be

achieved with a standard deviation of 2,339. The minimum score obtained by students was 10. Meanwhile, their maximum score was 21.

The students' logico-mathematical intelligence scores can be determined by calculating the Mi and SDi values according to the formula in Table 3.1. The category of logico-mathematical intelligence scores is presented in Table 2.

Table 2. Logico-mathematical Intelligence Score Category

No.	Interval	Frequency	(%)	Category
1.	$X > 19$	1	3,23	Very high
2.	$15 < X \leq 19$	14	45,16	High
3.	$10 < X \leq 15$	14	45,16	Moderate
4.	$6 < X \leq 10$	2	6,45	Low
5.	$X \leq 6$	0	0	Very Low
	TOTAL	31	100%	

Based on Table 2, it is known that the logico-mathematical intelligence of students is in the moderate category. There are one student whose logico-mathematical intelligence is in the very high category, and 45,16% of students whose logico-mathematical intelligence is in the high category. There are 45,16% of students whose logico-mathematical intelligence is in the medium category, and 6,45% of students whose logico-mathematical intelligence is in the low category.

b. Ability to Solve Mathematical Problems Based on the AKM

The number of questions in the student's numeracy literacy test was 10 items which 31 students then filled out. The results of the data analysis of students' numeracy literacy ability are presented in Table 3.

Table 3. Statistical Description of Numeracy Ability Variables

Statistics	Statistical Value
Sample Size	31
Mean	9,774
Median	11
Mode	11
Standard Deviation	2,860
Minimum Score	3
Maximum Score	14

Based on the data on students' numeracy literacy test scores, the average score of students' numeracy literacy ability was 9,774 of the ideal score of 25, which means that students in grade XII MIPA in SMAN 5 Sinjai are in the moderate category of numeracy literacy ability, which may be achieved with a standard deviation of 2,860. The minimum score obtained by students was 3. Meanwhile, their maximum score was 14.

Categorizing students' numeracy ability scores can be determined by calculating the ideal mean (Mi) and standard deviation (SDi) according to the categorization pattern in Table 3. The category of numeracy ability scores is presented in Table 4.

Table 4. Numeracy Ability Score Categories

No.	Interval	Frequency	(%)	Category
1.	$X > 19$	0	0	Very High
2.	$15 < X \leq 19$	0	0	High
3.	$10 < X \leq 15$	16	51,94	Moderate
4.	$6 < X \leq 10$	11	35,48	Low
5.	$X \leq 6$	4	12,9	Very Low

TOTAL	**31**	**100%**

Based on Table 4, it is known that there are 51,94% of students whose numeracy literacy ability is in the moderate category. There are 35,48% of students whose numeracy literacy ability is in the low category, and 12,9% of students whose numeracy literacy ability is in the low category.

2. Inferential Statistical Analysis

The results of an inferential statistical analysis based on research data analyzed with JASP software are as follows:

a. Classical assumption test

1) Normality Test

The results of the normality test using the Shapiro-Wilk test method in the JASP program are shown in Table 5.

Table 5. Normality Test Results

	Logico-mathematical Intelligence	Numeracy Ability
Shapiro-Wilk	0,955	0,937
P-value of Shapiro Wilk	0,216	0,069

Based on Table 5, each *p-value* $> 0,05$ means the data is normally distributed.

2) Linearity Test

The results of the linearity test data are presented in Table 6.

Table 6. Linearity Test Results

Variable	Sig.	Results
Logico-mathematical Intelligence	0,392	Linear

Table 6 shows that the independent variable has a linear relationship with the dependent variable, $p - value > 0,05$ so it can be concluded that all variables are linear.

3) Heteroscedasticity Test

The heteroscedasticity test aims to test whether, in the regression model, there is an inequality of variance from one observation to another (Ghozali, 2016). Heteroscedasticity can be seen in the test results with the residual vs. predicted scatterplot graph in Figure 2.
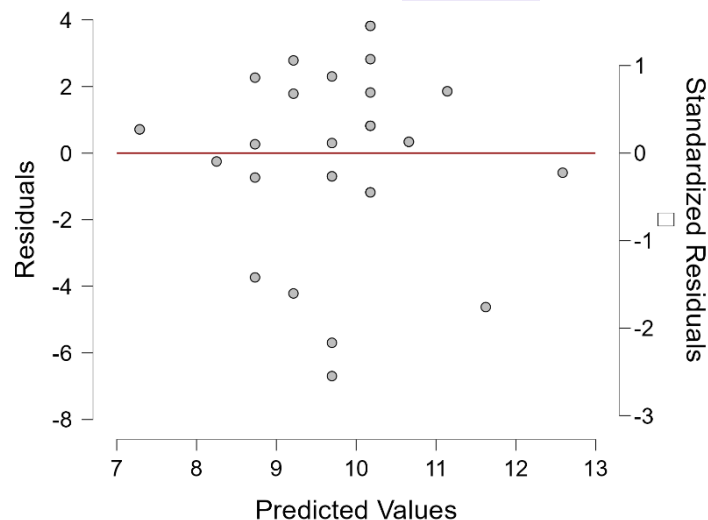
Figure 2. Heteroscedasticity Test Results

Based on the picture above, it can be seen that the points on the graph spread above and below zero on the Y-axis and do not form a specific pattern, meaning there is no heteroscedasticity.

b. Hypothesis test

1) T-test

The results of the T-test are shown in Table 7.

Table 7. T-Test Results

Coefficients

Model		Unstandardized	Standard Error	Standardized	t	p
H0	*(intercept)*	9.774	0.514		19.027	< .001
H1	*(intercept)*	2.468	3.200		0.771	0.447
	Logico-mathematical Intelligence	0.482	0.209	0.394	2.310	0.028

Based on the T-test results in Table 7 above, the p-value of the logico-mathematical intelligence variable is $0{,}868 > 0{,}05$ a t-value of $2{,}310$ (positive value). Due to the p-value>0,05 indicates a significant effect, which also means that logico-mathematical intelligence affects the ability to solve mathematical problems based on AKM (H_0 is rejected).

2) Coefficient of Determination R^2

According to (Ghozali, 2011), the coefficient of determination R^2 is used to determine the relationship between all independent variables (X) and the dependent variable (Y). The results of the R^2 (R Square) test are shown in Table 8.

Table 8. R Square Test Results

Model	R	R^2	Adjusted R^2	RMSE
H0	0.000	0.000	0.000	2.860
H1	0.394	0.155	0.126	2.674

Model Summary – Numeracy Ability

Based on Table 8, it is known that the R^2 test value is $0{,}155$ $15{,}5\%$ or, so this can be interpreted that the logico-mathematical intelligence variable only influences $15{,}5\%$ the ability to solve mathematical problems based on AKM. The remaining $84{,}5\%$ are explained by other factors not examined in this study that affect the ability to solve mathematical problems based on AKM.

B. Discussion

1. Variable characteristics

Based on the results of the previous data analysis, the average score of students' logico-mathematical intelligence was 15,161 of the ideal score of 25, which means that the overall logico-mathematical intelligence of students in class XII MIPA SMAN 5 Sinjai is in the moderate category. Logico-mathematical intelligence is a person's ability to logically collect, organize, and analyze a problem's relationship patterns in everyday life, solve mathematical operations, and research, interpret, conclude and predict a problem scientifically.

The average score of students' numeracy literacy ability was 9,774 of the ideal score of 25, which means that, in general, the numeracy literacy ability of class XII MIPA students of SMAN 5 Sinjai is in the moderate category. Numeracy is the knowledge and skill to use various kinds of numbers and symbols related to basic mathematics to solve practical problems in various contexts of everyday life, as well as analyze information presented in various forms (graphs, tables, charts, and so on) then use the interpretation of the results of the analysis to predict and draw conclusions and decisions.

2. Discussion of hypothesis testing

The simple linear regression equation of logico-mathematical intelligence and numeracy literacy ability is $Y = 2,468 + 0,482X$. The equation shows that each increase of one unit of logico-mathematical intelligence (X) can increase students' numeracy literacy ability by 0,482. Based on the regression results in Table 4.8, it is known that the logico-mathematical intelligence variable has a significant effect on numeracy literacy ability, which is 15,5%. The remaining 84,5% is influenced by other variables not examined in this study. It can be concluded that numeracy literacy ability can be predicted by logico-mathematical intelligence. This statement aligns with Ngazizah (2019) that logico-mathematical intelligence positively and significantly influences the ability to solve mathematical problems PISA-type.

Discussion

1. Variable characteristics

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2. Discussion of hypothesis testing

CONCLUSIONS AND SUGGESTIONS

A. Conclusions

Based on the results of research and discussion, it can be concluded that:

1. The logico-mathematical intelligence of students at grade XII MIPA in SMAN 5 Sinjai is in the moderate category, with an average score of 15,161 and a standard deviation of 2,339.
2. The ability to solve mathematical problems based on AKM of students at grade XII MIPA in SMAN 5 Sinjai is in the moderate category, with an average score of 9,774 and a standard deviation of 2,860.
3. The logico-mathematical intelligence positively affects the ability to solve mathematical problems based on AKM students at grade XII MIPA in SMAN 5 Sinjai.

B. Recommendations

Other researchers interested in researching numeracy literacy ability are expected to add other factors that may influence numeracy literacy ability, for example, self-efficacy, mastery of concepts, learning models, and others.

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