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The Relationship between Students' Learning independence and Mathematical Learning Outcomes on LCM and GCD Topics

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Abstract
The purpose of this research is to determine the relationship between students' learning independence and their mathematics learning outcomes. The study used a quantitative descriptive method with a sample of 41 seventh-grade students from SMPIT Al Fikri, selected through cluster random sampling. Data was collected using multiple-choice tests and questionnaires, each consisting of 30 items. The normality test yielded an L-count value of 0.073 and an L-table value of 0.150 at a significance level of 0.05, indicating a normal data distribution. The linearity test produced an F-count of 0.76 and an F-table of 2.63, showing a linear relationship between learning independence and mathematics outcomes. The Product Moment correlation test result was rxy = 0.642, indicating a moderate positive correlation. This shows that learning independence has a significant influence on mathematics learning outcomes, accounting for 41.19% of the effect, while 58.81% is influenced by other factors. The study concludes that there is a positive relationship between students' learning independence and their mathematics learning outcomes, particularly in the topics of *FPB* (Greatest Common Divisor) and *KPK* (Least Common Multiple), for seventh-grade students at SMPIT Al Fikri.

Keywords: FPB and KPK*, learning independence*, the mathematics learning outcomes.

1 INTRODUCTION

Learning independence is an internal factor originating from within students that influences their mathematics learning outcomes. According to Desmita et al. (in Larasati, 2020), learning independence can be defined as the ability to control and regulate one's own thoughts, feelings, and actions independently, as well as striving to overcome feelings of shame and doubt. Students who can manage their actions independently typically do not rely on others and have high self-confidence.

According to Bungsu et al. (2019), learning independence refers to a learning process within an individual aimed at achieving specific goals, requiring active individual participation without depending on others, including teachers. Students with learning independence have high initiative and creativity. They can set their own goals and understand that learning is not limited to school; it can also come from the internet or other books. They seek knowledge creatively.

Learning is a process and core activity that takes place in school. The success of educational goals depends on how students engage in the learning process. According to Skinner, learning is a behavior. When a person learns, their responses improve. Conversely, if they do not learn, their responses decline. Learning is considered a process when there is an internal change in a person that leads to a positive self-development. Oktarini et al. (2018) argue that learning outcomes are often used to measure how well someone has mastered the material taught. Learning outcomes in schools are usually reflected in scores or grades, which indicate whether students have met the minimum standards set by the school. Therefore, it can be said that students have achieved optimal success if their learning process meets these standards.

In daily life, mathematics is ever-present. It is used in offices, schools, markets, hospitals, restaurants, and other places. This means that mathematics plays a role in many aspects of life. Uno and Kuadrat (Larasati, 2020) state that mathematics is a discipline used as a tool for thinking, communication, and solving practical problems. It involves elements of logic, intuition, analysis, construction, generality, and individuality. Mathematics is a structured science in which experts have agreed to use concise symbols and terms that maintain clarity. If a practical problem were described using verbal language, it would be very long, but mathematics simplifies it with symbols. According to Kline (cited by Lysnawaty Simajuntak), the rise and fall of a country today depends on advancements in mathematics. Kline, quoted by Nur Rahmah, says that mathematics is not a standalone knowledge that can be perfect by itself; its primary purpose is to help people understand and solve social, economic, and natural problems. Mathematics makes life easier for people by solving many practical problems. It is a science perfected by other sciences, which is why mathematics is related to all aspects of life.

Students are expected to develop this factor to achieve optimal learning outcomes. The mathematics learning process typically begins with the introduction of concepts, examples provided by teachers, and practice exercises. However, students still consider mathematics a difficult subject. As a result, when given assignments, they rely more on their classmates, who are perceived as smarter. This dependency leads to a lack of full understanding of the material. This reliance makes students feel incapable of working independently during exams. When faced with tasks they must complete on their own, they find the questions difficult because there is no one to help. This results in poor scores.

2 RESEARCH METHODS

The goal of this research is to determine whether there is a relationship between students' learning independence and their mathematics learning outcomes in the topics of FPB (Greatest Common Divisor) and KPK (Least Common Multiple). The research was conducted at SMPIT Al Fikri, with the sample consisting of seventh-grade students enrolled in the odd semester of the 2024/2025 academic year.

The method used was a quantitative survey with a correlational technique. Correlational research is a general approach focused on interpreting the relationships between two or more variables without making any changes or manipulations to the existing data. The correlation technique in this study aims to solve the problem by determining the relationship between variables X and Y. The variables in this study are students' learning independence as the independent variable (X) and mathematics learning outcomes as the dependent variable (Y). The research design can be illustrated as follows:

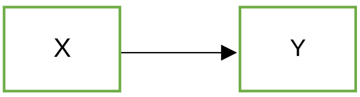

Figure 1. Correlation Research Design

The research instrument used to measure learning independence (variable X) was a questionnaire. To measure mathematics learning outcomes (variable Y), a test instrument was prepared in the form of multiple-choice questions. The test included 30 questions on the topics of FPB and KPK, designed based on the indicators of the seventh-grade mathematics curriculum and previous student learning outcomes. Before being used in the study, the questionnaire and test were tested for validity and reliability. Validity refers to the extent to which an instrument accurately measures what it is intended to measure, while reliability refers to the consistency of the instrument, ensuring that it yields the same results when used repeatedly. In addition to meeting validity and reliability requirements, the test instrument must also meet criteria for difficulty level and discriminating power.

The difficulty level indicates how challenging it is for students to understand the concepts, formulas, and symbols in the questions.

Data analysis was used to determine the significance of the relationship between students' learning independence and their mathematics learning outcomes in FPB and KPK. The steps taken in data analysis included prerequisite tests such as the Liliefors normality test and linearity test. Hypothesis testing was conducted using correlation tests, supported by significance testing with t-tests and the coefficient of determination test.

3 RESULT AND DISCUSSION

The processing of data on students' learning independence and their mathematics learning outcomes in grade VII at SMPIT Al Fikri was obtained through questionnaires and tests. This was done to determine the correlation between students' learning independence and their mathematics learning outcomes on the topics of FPB (Greatest Common Divisor) and KPK (Least Common Multiple) in grade VII at SMPIT Al Fikri.

3.1. Description of Students' Learning Independence Data (Variable X)

Based on the data collected from the questionnaire results, the minimum score for the learning independence variable was 87, and the maximum score was 125, with a range of 38, a number of class intervals = 5, and a class interval length = 7. After calculating the frequency distribution, the following were obtained:

- Mean = 106.5
- Median = 105.167
- Mode = 100.9
- Variance = 101.053
- Standard deviation = 10.052

Below is the frequency distribution table for the creation of the histogram and polygon for variable X (students' learning independence).

Table 1. Frequency Distribution of Variable X

Value	***f***	X_i	$f.X_i$	$X_i - \overline{X}$	$(X - \overline{X})^2$	$f(X_i - \overline{X})^2$	**Real Boundaries**
87 - 94	2	90.5	181	-16.0	256.00	512.00	86,5 - 94,5
95 - 102	6	98.5	591	-8.0	64.00	384.00	94,5 - 102,5
103 - 110	5	106.5	533	0.0	0.00	0.00	102,5 - 110,5
111 - 118	4	114.5	458	8.0	64.00	256.00	110,5 - 118,5
119 - 126	3	122.5	368	16.0	256.00	768.00	118,5 - 126,5
Sum	20	-	2130	-	-	1920.00	-

The research data presented in Table 2, when grouped based on the average score, shows that 10 students scored below the average, and 10 students scored above the average. The highest frequency was in the fourth class, and the lowest frequency was in the sixth class. Based on this information, the histogram and polygon graph can be illustrated as follows:

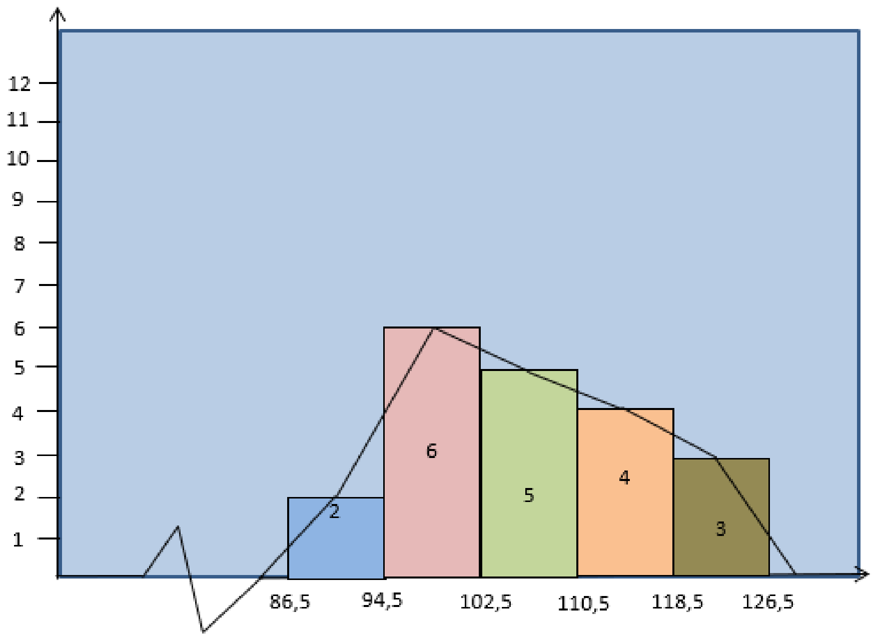

Figure 2. Histogram and Polygon Graph of Variable X

3.2 Description of Mathematics Learning Outcomes Data (Y)

From the research results obtained through the test questions, the lowest score was 2, and the highest score was 96, with a range of 20, 6 class intervals, and a class interval length of 11. After calculating the frequency distribution, the following were obtained:

- Mean = 89.40
- Median = 73.297
- Mode = 74.10
- Variance = 311.818
- Standard deviation = 17.658

Table 2. Frequency Distribution of Variable Y (Mathematics Learning Outcomes)

Value	***f***	X_i	$f.X_i$	$X_i - \bar{X}$	$(X - \bar{X})^2$	$f(X_i - \bar{X})^2$	**Real Bounderies**
20 - 45	2	40	80	-32.4	1046.52	2093.05	34,5 - 45,5
46 -56	3	51	153	-21.4	455.82	1367.47	45,5 - 56,5
57 - 67	1	71	71	-1.3	1.82	1.82	56,5 - 67,5
68 - 78	7	73	511	0.7	0.42	2.96	67,5 - 78,5
79 - 89	3	84	252	11.7	120.72	407.17	78,5 - 89,5
90 - 100	4	95	380	22.7	513.02	2052.09	89,5 - 100,5
Sum	**20**		1447	**-**	**-**	5924.55	**-**

Based on Table 3, students can be grouped as follows: 16 students scored below the average, and 19 students scored above the average.

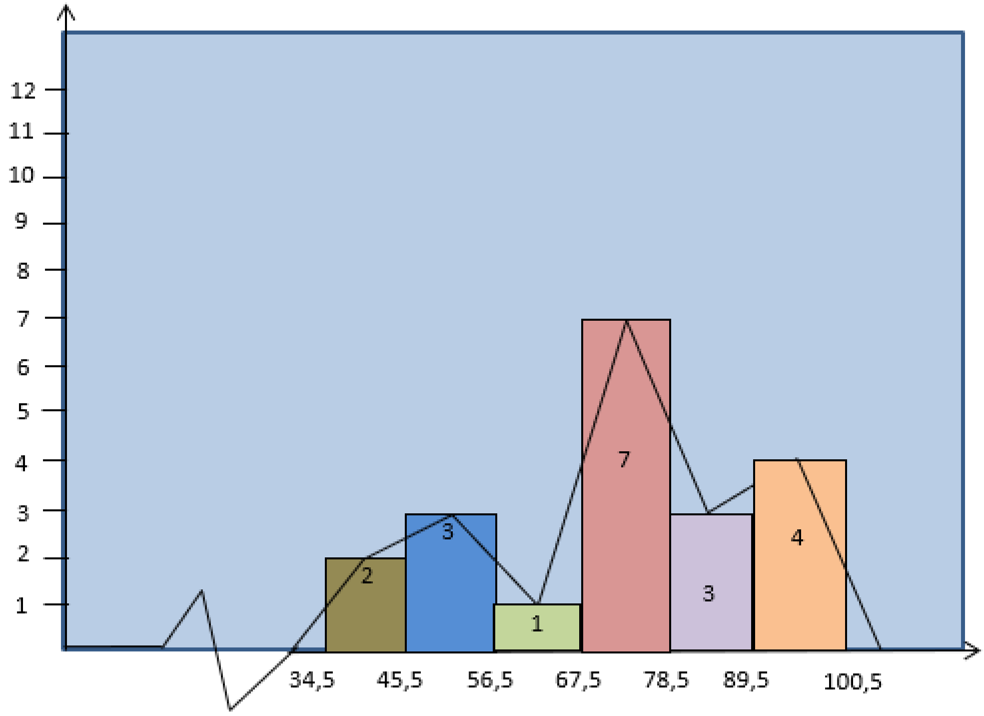

Figure 3. Histogram and Polygon Graph of Variable Y

3.3 Data Analysis Prerequisites Testing

The process of testing the data analysis prerequisites in this research is a crucial step that must be fulfilled before conducting the hypothesis testing. This testing is necessary because if the research data are not normally distributed, further analysis cannot be performed using the commonly used parametric methods. Therefore, prerequisite tests are carried out, which in this case is the normality test. The normality of the data was tested using the Lilliefors test, with the following results:

Table 3. Normality Test Results using the Lilliefors Test

No	Variable	Calculated Statistic		Conclusion
		$L_{calculated}$	L_{tabel} (α = 0,05 dan n=20)	
1	X	0,073	0,198	Normal
2	Y	0,120	0,198	Normal

Based on the Lilliefors test results presented in Table 3, the calculated L value for the student learning independence variable (X) is 0.073, while the calculated L value for the mathematics learning outcome variable (Y) is 0.120. Both values are less than the L table value (0.198). Therefore, it can be concluded that the data from both variables are from a normally distributed population.

Next, a linearity test was conducted to determine whether the two variables, X and Y, have a linear relationship. The simple linear regression equation is: Y = a + bX, where Y is the dependent variable (predicted value), X is the independent variable, a is the constant (Y value when X = 0), and b is the regression coefficient (indicating the increase or decrease). From the linearity calculation, the values obtained were a = -50.03 and b = 1.15, which were substituted into the regression equation as Y = -50.03 + (1.15) X.

Subsequently, an F-value calculation was performed, yielding F_calculated (F_obs) = 0.76. The F_table value at a significance level of 0.05 with degrees of freedom (14;4) = 3.11. Since F_calculated < F_table, it can be concluded that there is a linear relationship between student learning independence and mathematics learning outcomes on the topics of GCF and LCM. The summary of the linearity test results between variable X and variable Y is presented in Table 4.

Table 4. Linearity Test

Test	α	**Dk**	$F_{calculated}$	F_{table}	Decision
Linearity	0,05	14;4	0,76	3,11	H_0 accepted

3.4 Hypothesis Testing

After entering the values of variable X and variable Y into Pearson's Product-Moment correlation formula, the result is rxy = 0.642, and the r table = 0.334. Since r_calculated > r_table, this indicates a positive relationship between the student's learning independence variable and the mathematics learning outcome variable on GCF and LCM.

To assess the significance level, a t-test was performed. The results showed t_calculated = 3.550, and the t_table for a significance level of 0.05 with df = 18 is t_table = 1.734. Since t_calculated > t_table, it can be concluded that student learning independence (variable X) has a significant impact on mathematics learning outcomes on GCF and LCM (variable Y).

After confirming that variable X contributes significantly to variable Y, the next step is to calculate the contribution test using the coefficient of determination. This test aims to determine how much variable X contributes to or influences variable Y. The coefficient of determination is obtained by squaring the correlation coefficient.

Based on the calculations, the coefficient of determination was found to be 41.19%. This means that 41.19% of the variation in variable Y can be explained by variable X. In other words, variable X has a 41.19% influence on variable Y, while the remaining 58.81% is influenced by other factors not included in this research.

Table 5. Correlation and Determination Coefficient between Student Learning Independence and Mathematics Learning Outcomes on GCF and LCM

N	Coefficient		Significance Test	
	r	r^2	$t_{calculated}$	t_{tabel}
20	0,642	0,4382	3,550	1,734

The correlation coefficient is 0.642, and the determination coefficient is 41.19%. This correlation coefficient indicates a significant relationship between variable X and variable Y. A correlation coefficient of 0.642 suggests a moderately strong and positive relationship between the two variables. In the context of this research, this is important information as it shows that an increase in variable X is generally followed by an increase in variable Y. Meanwhile, the determination coefficient provides a clearer picture of how much variable X influences variable Y, which in this case is 41.19%. This information is crucial for understanding the dynamics between the two variables and can serve as the basis for further decisions or steps in the research.

3.5 Discussion of Research Results

Based on the calculations, 26 valid questionnaire items were found for variable X, and 23 valid test items were found for variable Y, as listed in Appendices 8 and 17. Reliability tests were conducted on both instruments, showing high reliability, making them suitable for use as research instruments. Further analysis was conducted with difficulty and discrimination power tests for the test items (variable Y). After the prerequisite tests were conducted, the valid questionnaire and test items were used as data collection instruments.

Data collection was followed by data processing and analysis, beginning with the prerequisite analysis tests: the normality and linearity tests. The normality test used the Lilliefors method. The normality test for variable X resulted in $L_{obs} = 0.064$ and $L_{table} = 0.150$, as shown in Appendix 30. Since $L_{obs} < L_{table}$, the data for variable X is confirmed to be normally distributed. The same process was applied to variable Y, yielding $L_{obs} = 0.073$ and $L_{table} = 0.150$, as shown in Appendix 31. Since $L_{obs} < L_{table}$, the data for variable Y is confirmed to be normally distributed.

After both variables were confirmed to be normally distributed, a linearity test was conducted to determine if there was a linear relationship between the two variables. The regression equation was calculated as detailed in Appendix 32, resulting in $F_{obs} = 0.76$ and $F_{table} = 3.11$. Since $F_{obs} < F_{table}$, the relationship between variable X and Y is linear. The regression linearity was found to be significant.

Following the confirmation of normal distribution and significant linear regression, hypothesis testing was conducted, as detailed in Appendix 33. The hypothesis test aimed to determine if there is a positive relationship between variable X (student learning independence) and variable Y (mathematics learning outcomes on GCF and LCM). Pearson's Product-Moment correlation test revealed that $r_{calculated} > r_{table}$ ($0.642 > 0.334$), indicating a positive relationship between the two variables. The positive value of "r" suggests that generally, as student learning independence increases, their ability to understand mathematics also improves.

Further significance testing between the two variables was performed, as shown in Appendix 34. The result was $t_{obs} > t_{table}$ ($3.550 > 1.734$). Based on these findings, it can be concluded that student learning independence significantly contributes to mathematics learning outcomes on GCF and LCM. After confirming that variable X contributes to variable Y, a contribution test was conducted using the coefficient of determination to determine the percentage of influence. The determination coefficient, as shown in Appendix 20, was found to be 41.19%. This means that 41.19% of mathematics learning outcomes on GCF and LCM are influenced by student learning independence, while the remaining 58.81% is influenced by other factors.

4 CONCLUSION

Based on the hypothesis testing results, the researcher concludes the following: There is a significant positive relationship between student learning independence and mathematics learning outcomes on GCF and LCM in Class VII at SMPIT Al Fikri during the 2024/2025 academic year. The strength of this relationship is demonstrated by the correlation test results. The calculated rxy value of 0.642 indicates a positive relationship between student learning independence and understanding of the GCF and LCM concepts. The correlation strength ($r_{xy} = 0.642$) and the significance test revealed that $t_{calculated} > t_{table}$ ($3.550 > 1.734$) at a 0.05% significance level, confirming that the correlation is significant. The coefficient of determination (KD) test showed that student learning independence contributes 41.19% to mathematics learning outcomes on GCF and LCM, while the remaining 58.81% is due to other factors.

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