

The Effect of Quran Memorization on Mathematical Understanding Ability with Pearson Correlation and Linear Regression

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Paiz Jalaludin paizjalaludin@darunnajah.ac.id	The benefit of memorizing the Quran trigger Islamic education mobilizers to integrate Quran memorization activities as one of the compulsory or extracurricular subjects in formal educational institutions.. This study aims to understand the relationship and influence of the Quran memorization index on students' mathematical abilities. The methods used to answer this problem are the Pearson correlation test and the simple linear regression test. Both statistical methods were rigorously reviewed in this study. The results of this study show that there is a significant relationship between the variable of the Quran memorization index and the mathematical understanding abilities of students at Pondok Pesantren Al-Hasanah Darunnajah 9 with a correlation coefficient of 0.428 which is included in the medium category. In addition, the results showed that there was a positive and significant influence between the Quran memorization index on students' mathematical abilities, where students' mathematical abilities were 18.3% influenced by the Quran memorization index, while the rest were influenced by other factors.
Keywords: Mathematical understanding abilities; Pearson correlation; linear regression; Quran Memorization.	

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INTRODUCTION

The activity of memorizing the Quran is a tradition that has been maintained continuously throughout the eras, since the era of the Holy Prophet until now, both those who speak Arabic and those who do not speak Arabic, such as Indonesian society (Rasyid, 2015). This is one of the miracles of the special Quran, where the Quran is a holy book that is easily memorized by everyone, across languages, nations, and ages (Al-Syahry, 2017). Even Allah Almighty will provide convenience in the process of memorizing the Quran, as Imam Al-Qurthubi (Al-Qurthubi, 2006) argues when interpreting Surah Al-Qamar: 15-17. In addition, Allah promises that people who always interact with the Quran, whether by listening, reading, or memorizing the Quran, will give rewards that are likened to businesses that will never lose, as stated in Quran 35:29. Some of the privileges of memorizing the Quran became a trigger for Muslims so that more and more educational institutions, both formal and non-formal, included Quranic *tahfizh* lessons in their curriculums.

The integration of Quran memorization subjects in formal schools is expected to have a positive impact on students' cognitive development and character building. The policy provides a wider space for students to not only learn general knowledge but they can also deepen religious knowledge through Quran memorization lessons. The verses of the Quran that students memorize are expected not only to be used as mere memorization, but the moral messages contained in the verses of the Quran can be practiced in everyday life so that they can form good character in themselves. The activity of memorizing the Quran requires discipline, perseverance, earnestness, concentration, and peace of mind. When these attitudes are carried out routinely in memorizing the Quran, it is expected to be implemented in learning activities of other subjects including general subjects such as science, physics, and mathematics so as to improve their learning achievement in all subjects.

The activity of memorizing the Quran does not contradict student achievement in general subjects in schools and universities, on the contrary memorizing the Quran can increase student achievement. A recent scientific study found that memorizing the Quran at an early age can strengthen memory and allow you to retrieve more information than children who do not memorize the Qur'an. It is said that 70% of students who start memorizing the Quran from an early age excel in their studies, and 60% of them can continue their studies up to university level in the faculties of medicine, engineering, pharmacy, and mathematics with proud achievements (Kamil, 2022).

Mathematics is one of the subjects that is considered difficult by most students in Indonesia. Student Mathematics learning achievement is the lowest compared to other subjects tested in the last national examination (Jalaludin et al., 2023). In addition, learning Mathematics also requires high concentration in understanding concepts, formulas, and solving problems given (Fatmi et al., 2022). Therefore, it takes a disciplined, diligent, earnest attitude and peace of mind in learning Mathematics. These attitudes, as mentioned earlier, are characteristics possessed by memorizers of the Quran. Thus, it can be said that there is a relationship between Quran memorization activities and Mathematics learning activities in schools. This problem prompted the authors to further confirm the correlation between the two by conducting scientific studies.

The authors tried to make initial observations to educational institutions that provide memorization of the Quran and Mathematics lessons as part of the national education curriculum. The educational institution used as an observation place is Pondok Pesantren Al-Hasanah Darunnajah 9, Pamulang South Tangerang. Based on the results of initial interviews with several teachers at the institution, related to the correlation and influence of memorization of the Quran on students' mathematical abilities, information was obtained that there are some students who have relatively much memorization of the Quran he also has good mathematical skills. However, there are also students who have relatively much memorization, but their mathematical thinking skills are mediocre or even lacking. Therefore, the author considers it necessary to conduct a scientific study to determine the relationship and influence between memorization of the Quran and students' mathematical abilities.

The basic mathematical abilities of students can be classified into five standards, namely: 1) mathematical understanding, 2) mathematical problem solving, 3) mathematical reasoning, 4) mathematical connections, and 5) mathematical communication (Sumarmo, 1987). The basic mathematical understanding abilities that will be the standard measurement in this study is the ability to understand mathematics. Comprehension ability is very important to master concepts that contain many formulas so that students can understand concepts comprehensively (Dini, 2017).

To measure students' mathematical understanding ability, several indicators are needed. In general, indicators of mathematical understanding include: knowing, understanding, and applying mathematical concepts, procedures, principles, and ideas (Sumarmo, 2010). In this study, indicators of mathematical comprehension ability to be used are indicators of understanding proposed by (Jihad & Haris, 2010), which are as follows: a) the ability to classify objects according to certain properties, b) the ability to use, utilize, and choose certain procedures or operations, c) the ability to apply concepts or problem-solving algorithms.

Some previous studies have stated that there is a positive correlation between memorization activities of the Quran with learning achievement and mathematical abilities such as research conducted by (Irsal & Yunita, 2022), (Faiziyah, 2018), (Hikmah et al., 2024), and (Yudha & Rohmadi, 2022). Meanwhile, other studies say that there is a positive and significant influence, memorization of the Qur'an on learning achievement, and mathematical understanding abilities, and / or students' mathematical thinking intelligence, such as research conducted by (Fatmi et al., 2022), (Asliyah & Ananda, 2022), and (Faiziyah, 2018).

Several previous studies have examined the correlation between the ability to memorize the Qur'an and students' mathematical understanding abilities as a dependent variable measured by different standards of mathematical understanding abilities. Some of the results of the study are as follows: there is a positive correlation between the ability to memorize the Qur'an with students' logical-mathematical intelligence (Irsal & Yunita, 2022), memorizing the Quran can increase mathematics learning achievement (Faiziyah, 2018), there is a significant positive correlation between the ability to memorize the Qur'an and students' mathematics learning achievement (Hikmah et al., 2024), and (Yudha & Rohmadi, 2022). Meanwhile, there are several other research studies examining the influence of the ability to memorize the Qur'an with students' mathematical abilities which are also measured by different ability standards, among the results of these studies are: there is a positive and significant influence between memorizing the Qur'an and understanding students' mathematical concepts (Fatmi et al., 2022), and there is a significant influence between memorizing Al-Quran and students' mathematical logical intelligence (Asliyah & Ananda, 2022). These studies tested only one of the "correlation" or "regression" aspects. In addition, as the dependent variable in the study, none of the studies used any of the five standards of mathematical understanding abilities according to the NCTM mentioned above.

This study tried to test simultaneously the correlation and influence between the ability to memorize the Qur'an with students' mathematical comprehension skills. The novelty of this study is the incorporation of testing the "relationship and "influence" of Quran memorization ability as an independent variable on students' mathematical understanding abilities as a dependent variable that has never been tested by previous research. This study aims to examine the correlation and effect of Quran memorization index and students' mathematical understanding abilities. The term Quran memorization index is a new term defined and introduced by the author in this study. To test the correlation and influence between the variables in this study, the authors will use the Pearson correlation test and simple linear regression. In addition, the author also conducted a rigorous review of the process of deriving formulas used in both types of statistical test methods.

RESEARCH METHOD

The study was conducted using quantitative methods. The variables in this study amounted to two variables, consisting of one dependent variable (Y) and one independent variable (X). The independent variable in this study is the student's Quran memorization index, while the dependent variable is the student's mathematical understanding abilities.

This research was carried out at Pondok Pesantren Al-Hasanah Darunnajah 9, Pamulang, South Tangerang City. This institution is one of the branches of Pondok Pesantren Darunnajah based in Jakarta. Pondok Pesantren Darunnajah is an institution that combines the national education curriculum, the curriculum of the ministry of religion, and the local curriculum which refers to the curriculum of Pondok Modern Darussalam Gontor (Pondok Pesantren Darunnajah, 2012) . The number of samples in this study was 72 samples, which were students of Pondok Pesantren Al-Hasanah Darunnajah 9 grade 5 TMI. The sampling technique in this study was carried out by stratified random sampling technique.

The data used to measure students' mathematical comprehension ability are the test scores of mathematics questions tested on students of Darunnajah Islamic Boarding School 9 grade 5 TMI. The test instrument is made according to the three indicators of students' mathematical ability mentioned above. While the data used to measure the memorization index of Quran students is primary data collected with a research instrument in the form of a questionnaire consisting of five questions compiled by the author as can be seen in Table 1

Table 1. Student Quran Memorization Index Questionnaire

No	Questions	Answers (in juz/hour)
1	How many juz of the Quran have you memorized?	
2	How many of your Quran memorization is fluent today?	
3	How much on average do you repeat your memorization every day?	
4	How many your average recitation of the Quran every day?	
5	How long on average time you spend memorizing, repeating and recitation every day	
Total		

There are two data analysis methods that will be used in this study, namely the Pearson product moment correlation method used to determine the relationship between variables, and the simple linear regression method used to determine the influence of the independent variable on the dependent variable. However, before the two tests are carried out, a classical assumption test will first be carried out as a prerequisite of both.

Pearson Correlation

Let X and Y be a numerical variable with normal distribution. Let X has n number measurement results consisting of x_1, x_2, \dots, x_n , and Y has n number measurement results consisting of y_1, y_2, \dots, y_n . Then, the pair of x_1 with y_1 , x_2 with y_2 , x_3 with y_3 , ..., x_n with y_n come from the same sample. Based on definition covariance value of X and Y , we get

$$\begin{aligned} cov(X, Y) &= E[(X - \bar{X})(Y - \bar{Y})] \\ cov(X, Y) &= \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{n - 1} \end{aligned}$$

with \bar{x} and \bar{y} are expectations (average) of X and Y . The definition variance X and Y are

$$Var(X) = E(X - \bar{X})^2 \text{ and } Var(Y) = E(y_i - \bar{y})^2$$

such that

$$Var(X) = \frac{\sum(x_i - \bar{x})^2}{n} \text{ and } Var(Y) = \frac{\sum(y_i - \bar{y})^2}{n}$$

So, we have the standard deviation of X and Y are

$$S_x = \sqrt{Var(X)} = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n}}$$

and

$$S_y = \sqrt{Var(Y)} = \sqrt{\frac{\sum(y_i - \bar{y})^2}{n}}$$

Correlation coefficient of X and Y symbolized by r_{xy} and defined as

$$r_{xy} = \frac{Cov(X, Y)}{S_x S_y}$$

such that

$$r_{xy} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2}}$$

and

$$-1 \leq r_{xy} \leq 1 \quad (i)$$

Next, it will be shown why the statement (i) applies.

To begin with, the range of correlation coefficient is not 0 and 1, but rather -1 and 1 . Its absolute value is limited to a range 0 to 1, which will come in handy later. This ratio is all that correlation coefficient is

$$r_{xy} = \frac{Cov(X, Y)}{\sqrt{Var(X)}\sqrt{Var(Y)}}$$

The denominator is ≥ 0 since both variances are by definition non-negative. A singularity can only happen if there is no variance in one of the variables. The covariance of two random variables is zero if they are completely uncorrelated, or independent. Therefore, 0 is a reasonable lower bound for the expression's absolute value. This can be displayed as follows:

$$Cov(X, Y) = E[(X - \bar{X})(Y - \bar{Y})] = E[XY] - E[X]E[Y]$$

If two random variables are independent, then

$$E[XY] = E[X]E[Y]$$

and

$$Cov(X, Y) = E[(X - \bar{X})(Y - \bar{Y})] = E[XY] - E[X]E[Y] = 0$$

We use the Cauchy-Schwarz inequality on the upper bound such that

$$\begin{aligned} |Cov(X, Y)|^2 &\leq Var(X)Var(Y) \\ |Cov(X, Y)| &\leq \sqrt{Var(X)}\sqrt{Var(Y)} \end{aligned}$$

Entering this outcome of Cauchy-Schwarz inequality into the formula for r_{xy} , we get

$$\begin{aligned} |r_{xy}| &= \left| \frac{Cov(X, Y)}{\sqrt{Var(X)}\sqrt{Var(Y)}} \right| \\ &\leq \frac{\sqrt{Var(X)}\sqrt{Var(Y)}}{\sqrt{Var(X)}\sqrt{Var(Y)}} = 1 \end{aligned}$$

As a result, the correlation's absolute value is constrained by 1 above and 0 below.

Before conducting the Pearson correlation test, a data normality and linearity test will first be carried out as a prerequisite. The correlation testing process will use the help of IBM SPSS 26 software.

The research hypothesis for the Pearson correlation test is as follows

H0 : There is no significant correlation between the Quran memorization index variable and students' mathematical abilities.

H1 : There is a significant correlation between the Quran memorization index variable and students' mathematical abilities.

To test both hypotheses, the following calculated formula t can be used:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

The rule of thumb of hypothesis testing above is “reject H_0 if $|t_{count}| > t_{\alpha, n-2}$ ”. The process of testing the correlation test hypothesis in this study will take advantage of the IBM SPSS 26 software so that the hypothesis testing becomes “reject H_0 if the p-value < 0.05 ”.

Simple Linear Regression

Suppose a set of random samples of size n is expressed in an ordered set of pairs $\{(x_i, y_i); i = 1, 2, \dots, n\}$, where X is the independent variable and Y is the dependent variable that is probabilistic. Statistical models of simple linear regression can be expressed as

$$y_i = \beta_0 + \beta_1 x_i + \varepsilon_i$$

where β_0 and β_1 are unknown intercepts and slopes, and ε are model errors that are components of random variables with $E(\varepsilon) = 0$. An illustration of this model can be seen in Figure 1 (Walpole & Myers, 2011).

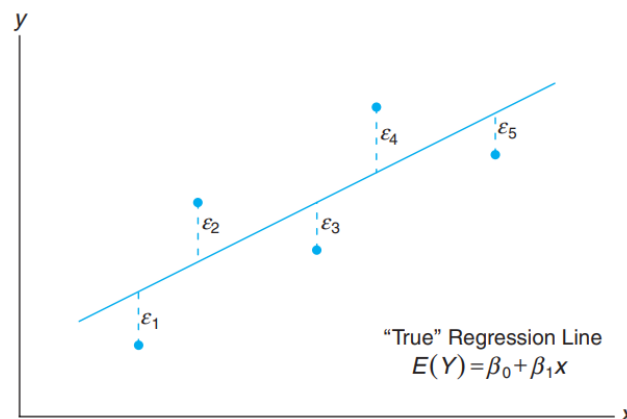


Figure 1. Hypothetical (x, y) data scattered around the true regression line

Suppose a is the β_0 estimator and b is the estimator for β_1 , then the estimated or fitted regression line satisfies

$$\hat{y} = a + bx$$

where \hat{y} is the fitted value. Each observation pair will satisfy

$$y_i = a + bx_i + e_i$$

where e_i is a residual that satisfies $e_i = y_i - \hat{y}$ and gives an error in the fitted model at the i -th data point. The difference between e_i and ε_i can be seen in Figure 2 (Walpole & Myers, 2011).

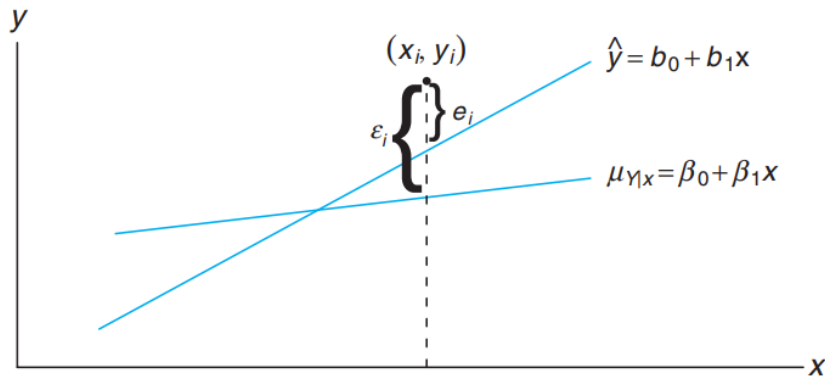


Figure 2. Comparing ε_i with the residual, e_i

Furthermore, to find estimators a and b , the Ordinary Least Square (OLS) method will be used. The main problem in this model is finding a and b such that the sum of squares of the errors (SSE) is minimum.

$$SSE = \sum_{i=1}^n e_i^2 = \sum_{i=1}^n (y_i - \hat{y})^2 = \sum_{i=1}^n (y_i - a - bx_i)^2$$

Then we partially differentiate SSE against a and b such that it is obtained

$$\frac{\partial(SSE)}{\partial a} = -2 \sum_{i=1}^n (y_i - a - bx_i) = 0$$

which can be simplified to the form of normal equations

$$na + b \sum_{i=1}^n x_i = \sum_{i=1}^n y_i \quad (ii)$$

and

$$\frac{\partial(SSE)}{\partial b} = -2 \sum_{i=1}^n (y_i - a - bx_i)x_i = 0$$

such that

$$a \sum_{i=1}^n x_i + b \sum_{i=1}^n x_i^2 = \sum_{i=1}^n x_i y_i \quad (iii)$$

The solution of the equation (ii) and equation (iii) for a and b are

$$a = \frac{\sum_{i=1}^n y_i - b \sum_{i=1}^n x_i}{n} \quad (iv)$$

and

$$b = \frac{n \sum_{i=1}^n x_i y_i - (\sum_{i=1}^n x_i)(\sum_{i=1}^n y_i)}{n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2} \quad (v)$$

There are several classical assumption tests that must be considered before performing a linear regression test. According to (Gujarati, 2003) and (Yamin, 2021), the assumption test for linear regression is the residual normality test and the linearity test. In this study, the authors will use SPSS 26 software to perform a simple linear regression test along with a classic assumption test.

The research hypothesis for the regression test in this study is as follows:

H0 : The Quran memorization index has no significant effect on students' mathematical understanding abilities.

H1 : The Quran memorization index has significant effect on students' mathematical understanding abilities.

Rule of thumb hypothesis testing regression test with IBM SPSS 26 is "reject H0 if p-value < 0.05".

RESULTS AND DISCUSSION

Normality and Linearity Test

Before conducting the Pearson correlation test, normality and linearity tests were first carried out on 76 sample data. The output of IBM SPSS 26 showing the results of the normality test with Kolmogorov-Smirnov in Table 2 which shows that the significance value of the normality test for variable X is equal to 0.087 while for variable Y is equal to 0.065. Because the significance of the normality test of the two variables is more than 0.05, it can be concluded that the data of the two variables are distributed normally. The output of IBM SPSS for the linearity test can be seen in Table 3, where the significance level of the linearity test between the independent variable and the dependent variable is 0.00 less than 0.05. Thus, it can be concluded that the relationship between the two variables is linear. Because both conditions are met, namely the data is normally distributed and has a linear relationship, it can proceed to Pearson correlation testing.

Table 2. IBM SPSS output normality test results

Variables	Kolmogorov-Smirnov ^a		
	Statistic	df	Sig.
Quran memorization index (X)	.097	72	.087
Mathematical understanding abilities (Y)	.101	72	.065

Table 3. IBM SPSS output linearity test results

			F	Sig.
Quran memorization index	Between Groups	(Combined) Linearity	3.100	.001
* Mathematical understanding abilities	Within Groups		29.571	.000
	Total			

Pearson Correlation Test

The next stage is to conduct a Pearson product moment correlation test to find out if there is a significant correlation between the Quran memorization index and students' mathematical abilities. The output of IBM SPSS correlation test results can be seen in Table 4.

Table 4. IBM SPSS output Pearson correlation test results

Correlations			
		Quran memorization index	Mathematical understanding abilities
Quran memorization index	Pearson Correlation	1	.428**
	Sig. (2-tailed)		.000
	N	72	72
Mathematical understanding abilities	Pearson Correlation	.428**	1
	Sig. (2-tailed)	.000	
	N	72	72

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

Based on Table 4, the p-value of the Pearson correlation test was $0.00 < 0.05$ which caused the rejection of the H_0 hypothesis, so it can be concluded that there is a significant correlation between the memorization index of the Quran and students' mathematical abilities with a regression coefficient value of $r_{(x,y)}=0.428$. Thus, the strength of the correlation between the memorization index of the Quran and mathematical understanding abilities is moderate (Yamin, 2021).

The next stage is a simple linear regression test to find out whether the Quran memorization index variable has a significant effect on students' mathematical abilities. However, before the regression test is carried out, a residual normality test will be carried out as a prerequisite.

Residual Normality Test

Table 5. Output IBM SPSS for residual normality test results

		Unstandardized Residual
N		72
Normal Parameters ^{a,b}	Mean	.0000000
	Std. Deviation	2.00873706
Test Statistic		.070
Asymp. Sig. (2-tailed)		.200 ^{c,d}
Exact Sig. (2-tailed)		.853
Point Probability		.000

The normality test in regression is used to determine whether the reciprocal value between variables X and Y is normally distributed or not. The output of residual normality test results can be seen in Table 5 which shows that the

significance value of the residual data normality test is $0.853 > 0.05$, so it can be concluded that the residual data is normally distributed. As for the relationship of linearity between the two variables, it was already indicated in the previous section.

Simple Linear Regression Test

The linear regression test was carried out with the aim of testing whether the Quran memorization variable had a significant effect on students' mathematical abilities. The output of IBM SPSS showing regression test results can be seen in Table 5. The p-value of the regression test is $0.00 < 0.05$. Thus, reject the H_0 hypothesis, so it can be concluded that the Quran memorization index variable has a significant effect on students' mathematical abilities. In addition, based on Table 5, it is known that the value of the constant $a=3.266$ and the value of $b=0.510$ so that the simple linear regression equation in this regression problem is

$$Y = 3,266 + 0,51 x$$

The regression equation above explains that every 1% addition to the Qur'an memorization index increases students' mathematical understanding abilities by 0.51. In addition, the equation also showed that the mathematics ability of students who were not affected by changes in the memorization index of the Quran was 3.266.

Table 5. IBM SPSS output linear regression test results

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.266	.572		5.712	.000
	Quran Memorization Index	.510	.129	.428	3.964	.000

a. Dependent Variable: Mathematical understanding abilities

Table 6. Value of Correlation Coefficient and Determination Coefficient

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
1	.428 ^a	.183	.172	2.02303	

a. Predictors: (Constant), Quran Memorization Index

Table 6. Explains that the value of the correlation coefficient between variables X and Y is 0.428, which indicates that the degree of strength of the relationship between the two variables is medium, as explained in the previous section. The value of the coefficient of determination, R Square is obtained at 0.183, which contains the understanding that the influence of the Quran memorization index on students' mathematical abilities is 18.3%.

Memorizing the Quran is an activity that requires discipline, perseverance, thoroughness, sincerity, and peace of mind. In addition, according to (Fatmi et al., 2022) memorizing the Quran also requires activities that require high concentration. If these attitudes are continuously carried out, a memorizer of the Quran will gradually have positive behaviors embedded in him, where these behaviors he has done as mandatory activities when memorizing the Quran. If a person has disciplined, conscientious, earnest behavior, a calm spirit, and high concentration then the chances of him succeeding in learning other subjects are very high. This is confirmed by a theory that states that the success rate of children who memorize from an early age reaches 70%, and 60% of them survive can continue their education to the university level with proud achievements in Faculty of Medicine, Engineering and Pharmacy (Kamil, 2022).

In line with the theory above, the results of this study show that there is a positive and significant correlation between the Quran memorization index and their mathematical understanding ability, with a correlation coefficient of 0.428, which is included in the medium category. This is in line with some previous research such as research conducted by (Faiziyah, 2018), (Irsal & Yunita, 2022), (Hikmah et al., 2024) and (Yudha & Rohmadi, 2022).

In addition, the results of this study which showed a significant positive influence, the memorization index of the Quran in Pondok Pesantren Darunnajah 9 is in line with the results of previous studies such as research conducted by (Fatmi et al., 2022), (Asliyah & Ananda, 2022) and (Faiziyah, 2018). This reinforces the initial assumption that reciting the Quran can improve student achievement, especially in Mathematics.

This study uses the ability to understand mathematics as a dependent variable which is one of the five standards of mathematical ability proposed by NCTM, and the results show that there is a positive and significant relationship and influence. Keep in mind that mathematical comprehension ability is the lowest standard among several other ability standards. Therefore, the authors recommend that subsequent researchers examine the relationship and influence of memorization of the Qur'an on four other higher-level standards of mathematical ability: mathematical problem solving, mathematical reasoning, mathematical connections, and mathematical communication.

CONCLUSION

The term Quran memorization index which is used as an indicator to measure students' memorization of the Quran both in quantity and quality introduced for the first time in this study includes aspects of the number of memorization, quality of memorization, quantity of recitation of the Quran, and duration of time used to interact with the Quran. From some of the results and discussions above, it can be concluded that there is a significant and positive correlation between the memorization index of the Quran and the mathematical understanding abilities of students at the Al-Hasanah Darunnajah Islamic Boarding School 9. In addition, the results of the study also showed that there was a positive and significant influence of the Quran memorization index on the mathematical

understanding abilities of students in the same place. The variable mathematical understanding abilities of students 18.3% is influenced by the memorization index of the Quran and the rest is influenced by other factors.

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