JPPIPA 9(5) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

The Relationship between Science and Mathematics Student Learning Outcomes

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Received: March 27, 2023
Revised: May 25, 2023
Accepted: May 28, 202
Published: May 31, 2023

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DOI: 10.29303/jppipa.v9i5.3684

Abstract: This article discusses the relationship between mathematics learning outcomes and natural science learning outcomes at East Teluk Jambe 1 Public Middle School in 227 students from nine classes at the end of the odd semester of the 2022/2023 Academic Year. The relationship between these two subjects can be seen from the results of mathematics learning scores and science learning scores by looking at the relationship that occurs based on student ability categories, namely the High Mathematics Category (HMC) and the Low Mathematics Category (LMC), the High Science Category (HSC), the Low Science Category (LSC) is then also seen based on the overall value of mathematics and science. The statistical test used is a correlation test to see each relationship. The results obtained the overall value of mathematics learning outcomes will have a sufficient influence on the overall value of science learning outcomes and vice versa, the effect of a sufficient relationship in the value of mathematics learning outcomes on science or vice versa occurs when students' learning abilities in mathematics or science are high. The overall mathematics learning result is 83.20 while the average science learning result is 85.63, and the science score is higher than the math score. Students who study mathematics will have an influence on learning science, and vice versa students who study mathematics will have an influence on learning mathematics so that these two subjects must be given to students.

Keywords: Learning Outcomes; Mathematics; Science

Introduction

Education is a process of activity which aims to develop and improve the basic abilities that exist in a person (Qistina et al., 2019). Learning mathematics is not easy because it contains certain concepts and structures that must be learned, so that when someone learns mathematics, he is developing the abilities and skills that exist within him. Thus students who study mathematics, an understanding of the concepts and structure of the material makes it easier for students to remember the material Kenedi et al. (2019), because the material studied in it has a structured pattern. Mathematics are abstract ideas given symbols, therefore mathematical concepts must be understood before manipulating the symbols used. Good mathematics learning will produce good mathematics learning outcomes, because mathematics learning outcomes are a combination of various domains of attitude or behavior, cognitive/knowledge, and psychomotor/skills.

Burton's learning outcomes Baslemen (2011) suggest "Learning is a change in the individual, due to interaction of that individual and his environment, which fills a need and makes him more capable of daeling adequately with his environment", while Hilgard (Sjukur, 2012) stated "Learning is a process by which an activity originates or changed through training procedures (wether in a laboratory or in the natural environment) as distinguished from changes by factors not attributable to training", as stated by James O. Whittaker (Aunurrahman, 2019) that learning is a process in which behavior is generated or changed through practice or experience.

How to Cite:
Hakim, D.L. (2023). The Relationship between Science and Mathematics Student Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 3890–3898. https://doi.org/10.29303/jppipa.v9i5.3684

From the various definitions presented, it can be concluded that learning is an activity that is carried out consciously and produces a change that exists in a person (Engeström & Sannino, 2021). In learning mathematics to get good mathematics learning outcomes students must construct their own concepts learned through concrete objects. This makes them understand and tend to remember the concept. By learning mathematics, a person's character or character can be fostered or developed. This happens because learning mathematics can develop concentration power, increase the ability to express opinions briefly and precisely, think rationally and make appropriate decisions.

Rusmono (2014) even suggests that learning outcomes are changes in behavior which include three domains, namely the cognitive, affective, and psychomotor domains (Fadhilla, 2023). The cognitive domain, it includes learning objectives related to bringing back knowledge and developing intellectual abilities and skills (Fakhriyah et al., 2022), while the affective domain includes learning objectives that indicate changes in attitudes, interests, and values, in addition to the psychomotor domain, it includes changes behavior that shows students are able to manipulate certain objects.

There are so many learning outcomes that can provide beneficial value in students' lives not only from a cognitive perspective but also develop their skills. Learning mathematics students are able to understand a concept of congruence (geographical space) that can be applied in everyday life (Machaba & Dhlamini, 2021), then students are also able to communicate mathematical ideas in mathematical concepts and can provide clear representations related to a concept (Ayu & Hakim, 2020; Maulyda et al., 2020). In addition, students' mathematics learning outcomes can also provide problem solving regarding students' difficulties by thinking critically as conveyed (Zahra & Hakim, 2022) on the material lines, angles and (Erlita & Hakim, 2022) on the concept of flat shapes. Even learning independence is increasing Hakim (2017), the same as what was conveyed, and also students are better at counting (Nurfadilah & Hakim, 2019).

Good student learning outcomes are supported through a good learning process such as the STAD model can achieve mathematical abstraction abilities, or RME learning (Wiyanti et al., 2021) which has an influence on the results achieved in learning, even current learning such as mobile learning which is able to provide good improvements in student learning independence. Even this process is supported by the ability of educators to further optimize various sources/learning media because there are still many educators who require skills in preparing various learning needs. As is the case (Hakim, 2022) teacher competence increases with training, even during a pandemic, skills to improve teacher competence are needed (Hakim et al., 2023). So that from this good competency can make various tools / media needed for the learning process so that with the help of teaching aids such as saldermath algebra (Hakim, 2017) can improve their algebraic skills.

In contrast to the results of learning science (Natural Science), in the process of studying events that occur in nature by carrying out observations, experimentations, inferences, preparation of theories so that students' knowledge increases, as well as organized ideas and concepts about the natural surroundings, which are obtained from experience through the scientific process of inquiry. Basically the process obtained for mathematics learning outcomes and science learning outcomes is not much different because in science they are more in the context of real objects while mathematics is abstract objects. Therefore, from this there is a need for further study of the relationship between mathematics learning outcomes and science learning outcomes.

Method

In research using a quantitative approach. (Creswell, 2012) says that "Quantitative approaches use more closed-ended approaches in which the researcher identifies set response categories" and even Sugiyono (2017) says that a quantitative approach is research that is based on the philosophy of positivism to research certain populations or samples and take random samples random with data collection using instruments, as well as statistical data analysis. In this study using a survey method. Creswell & Creswell (2018) reveals "survey research designs are procedures in quantitative research in which investigators administer a survey to a sample or to the entire population of people to describe attitudes, opinions, behaviors, or characteristics of the population", even (Sugiyono, 2015) said the survey method was used to obtain data from certain natural (not artificial) places. The design in this study showed by Figure 1.

The design of this study in Figure 1 was made to see the relationship that occurs between Mathematics Learning Outcomes (X) and Science Learning Outcomes (Y), as a whole (X, Y) and based on High and Low categories (X1,, X2, Y1, Y2). The data used is the final cumulative value used by the teacher on all tests carried out at school for one semester, namely the Odd Semester of the 2022/2023 academic year from the entire population of class IX SMPN 1 Teluk Jambe Barat students, totaling 227 students from 6 existing classes so

that the population is used as a sample as a whole or a saturated sample (Arikunto, 2019).

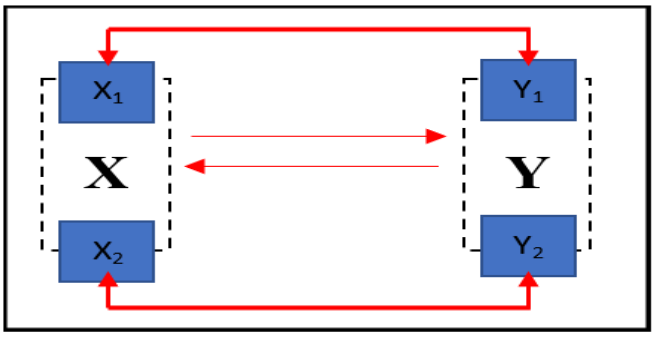

Figure 1. Research Design

Result and Discussion

Grade IX junior high school students are students whose presence is at the end of the learning process for the junior high school level, in the process and learning outcomes expected in learning mathematics and science, including several things, including those contained in the existing content and curriculum framework. The following is the overall result of the math scores and science scores obtained by students at the end of the Odd Semester of the 2022/2023 Academic Year.

Table shows the average score of students' school examination results from six classes at SMP Negeri 1 Telukjambe Barat for 227 students. The data shows how the distribution of average scores for mathematics and science learning outcomes. Overall, based on these six classes, the average score for learning mathematics at SMP 1 Telukjambe Barat is 83.20 with a standard deviation of 2.82 and the difference in the average score in each class is not too much different. The lowest average score for mathematics learning is Class C at 82.53 while the highest average score for mathematics learning is Class B at 84.31. Then the average value of science learning outcomes at SMP 1 Telukjambe Barat Overall based on the six classes, the average score for science learning outcomes at SMP 1 Telukjambe Barat is 85.62 with a standard deviation of 3.01 and there are differences in some classes earned average. The lowest average value of science learning outcomes is Class F at 82.92 while the highest is Class B at 87.18.

In Figure 2, we can see a comparison of the highest scores and lowest scores between the average grades of mathematics learning outcomes and the average grades of science learning outcomes in each class as a whole class is different, that is, the average score of science learning outcomes is the highest while the average score Mathematics learning outcomes are the lowest, at 87.18, namely the average value of science learning outcomes in class F and 82.53, namely the average value of mathematics learning outcomes in class C. The standard deviation shown from the two is also different where class F is 3.20 while for Class C the average value of learning outcomes is 2.76.

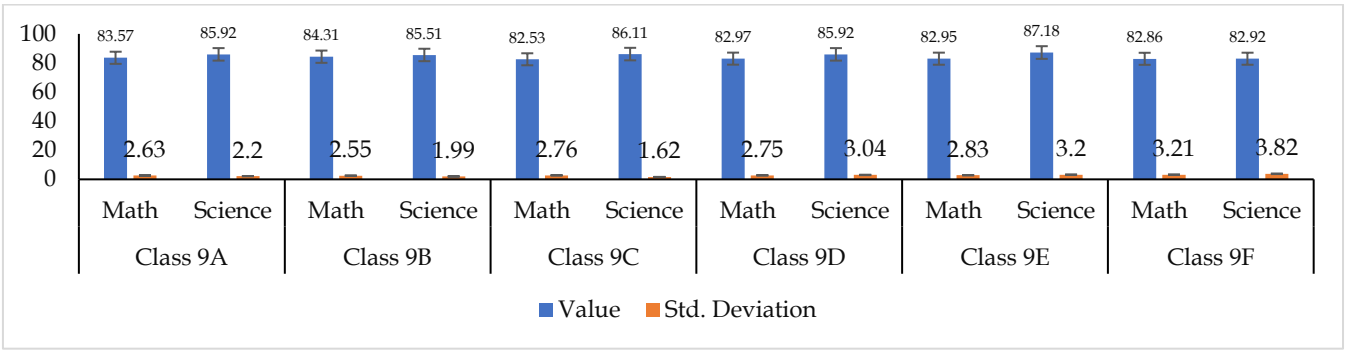

Figure 2. School Test Scores

The average score for each class presented here is the score obtained by students when carrying out the School Examination in the Odd Semester of the 2022/2023 Academic year, which is divided into six classes of 227 students. The student scores obtained will be processed for statistical tests to show some of the relationships that occur between mathematics learning outcomes and science learning outcomes. Furthermore, student scores are grouped based on several different sides, namely based on the score of mathematics learning outcomes in the high category of mathematics (HMC) and the low category of mathematics (LMC), then the value of science learning outcomes in the high category of Science (HSC) and the low category of mathematics (LSC), and lastly the overall value of Mathematics learning outcomes (KM) and Science learning outcomes (KI).

In grouping based on high and low ability categories, it is carried out using the rules for calculating the Average Value of Learning Outcomes (μ), for the High Category the value is greater than or equal to the average, for the Low Category the value is less than the average, based on This calculation results as shown in Table 1.

Based on the results of the calculations presented in Table 1, it is obtained that the value grouping of mathematics learning outcomes in the High Mathematics Category (HMC) is 128 students, and the Mathematics Low Category (LMC) is 99 students. As for the grouping of science learning outcomes in the High Science Category (HSC) there are 98 students and the Low Science Category (LSC) is 129 students. Furthermore, the data on the value of the learning outcomes is tested statistically based on two groupings, namely as a whole and based on the group category of each value of learning outcomes in mathematics and science learning outcomes, the data is tested to find out some of the relationships that occur.

Table 1. Description of the value of student learning outcomes

Categori	Math	N	μ Math	μ Science	Science	N	μ Matha	μ Science
High	$N \geq 83$	128	80.48	86.66	$N \geq 86$	98	84.84	88.31
Low	$N < 83$	99	85.22	84.27	$N < 86$	129	81.96	83.58

Based on Table 1, the value of student learning outcomes based on the High Mathematics Category (HMC) for the average value of mathematics learning outcomes is 80.48 while the average value of science learning outcomes is 86.66, while the value of student learning outcomes is based on the Low Mathematics Category (LMC). For the Low Mathematics Category (LMC), a statistical test will be used, namely parametric or non-parametric, but before the test is carried out, a prerequisite test is carried out, namely to see whether the data is normally distributed or not, thus showing the test to be carried out next, as for the test results The normality of the data obtained is as follows:

Table 2. Normality test based on HMC, LMC One-Sample Kolmogorov-Smirnov Test

Normal Parameters		Most Extreme Differences			Test Statistic	Asymp.Sig (2-tailed)	N
Mean	Std. Deviation	Absolute	Positive	Negative			
0.0000000	2.620848	0.087	0.061	-0.087	0.087	0.019^0	128
0.0000000	2.77932249	0.171	0.171	-0,162	0.171	0.000^0	99
0.0000000	1.70323704	0.092	0.092	-0.073	0.092	0.010^0	128
0.0000000	0.80909206	0.403	0.403	-0.248	0.403	0.010^0	99

a. Test distribution is Normal
b. Calculated from data
c. Liliefors Significance Correction

Relationship between Mathematics and Science Learning Outcomes based on HMC and LMC

As seen in Table 2, the average value of student learning outcomes based on the High Mathematics Category (HMC) for Mathematics Learning Outcomes scores can be concluded that, the value of mathematics learning outcomes based on HMC is not normally distributed with a value of 0.019 because it is less than a significance value of 0, 05, while the average value of student learning outcomes based on the Higher Mathematics Category (HMC) for Science Learning Outcomes scores can be concluded that, the value of Science learning outcomes based on HMC is not normally distributed with a value of 0.010 because it is less than a significance value of 0.05. Because the scores for mathematics learning outcomes and science learning outcomes based on HMC were both not normally distributed, a non-parametric statistical test was carried out because one or both of the data were not normally distributed. The non-parametric test used to test the relationship between mathematics learning outcomes and science learning outcomes based on the Mathematics Higher Group (HMC) category is using the Spearman Test (Colleges, 2022).

Then the average value of student learning outcomes based on the Low Mathematics Category (LMC) for the value of Mathematics Learning Outcomes can be concluded that, the value of mathematics learning outcomes based on LMC is not normally distributed with a value of 0.000 because it is less than a significance value of 0.05, while the average the value of student learning outcomes based on the Low Mathematics Category (LMC) for the value of Science Learning Outcomes it can be concluded that, the value of science learning outcomes based on LMC is not normally distributed with a value of 0.000 because it is less than a significance value of 0.05. Because the scores for mathematics learning outcomes and science learning outcomes based on LMC were both not normally distributed, a non-parametric statistical test was carried out because one or both of the data were not normally distributed. The non-parametric test used to test the relationship between mathematics learning outcomes and science learning outcomes based on the Mathematics Low Group (LMC) category is the Spearman Test.

Based on the HMC and LMC groups, all of them in the normality test were not normally distributed, so as a whole to see the relationship of all of them using the

Spearman Test to see the correlation that occurred, while the statistical test results shown in Table 3.

Table 3. Correlation Test based on HMC, LMC Nonparametric Correlation

			HMC	Science_HMC	LMC	Science_LMC
Spearman's sh	HMC	Correlation Coefficient	1.000	0.333**	-0.009	-0.062
		Sig. (2-tailed)		0.000	0.932	0.545
		N	128	128	99	99
	Science_HMC	Correlation Coefficient	0.333**	1.000	0.149	-0.146
		Sig. (2-tailed)	0.000		0.142	0.150
		N	128	128	99	99
	LMC	Correlation Coefficient	-0.099	0.149	1.000	-0.025
		Sig. (2-tailed)	0.932	0.142		0.082
		N	99	99	99	99
	Science_LMC	Correlation Coefficient	-0.062	-0.146	-0.025	1.000
		Sig. (2-tailed)	0.545	0.150	0.802	
		N	99	99	99	99

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

The results of the first correlation test shown in Table 3 shows that the value of students' mathematics and science learning outcomes for the High Mathematics Category (HMC) shows a correlation test value of 0.000 which is smaller than the significance value of 0.05 so that it can be concluded that there is a relationship between the high mathematics learning achievement scores and the science learning outcomes scores, and the relationship shows a positive relationship which is quite equal to 0.333. However, inversely proportional to the value of students' mathematics and science learning outcomes for the Low Mathematics Category (LMC) shows a correlation test value of 0.802 greater than the significance value of 0.05 so it can be concluded that there is no relationship between the value of low mathematics learning outcomes and the value of learning outcomes IPA, and the relationship shows a very weak negative relationship, namely -0.025.

The meanings obtained from these statistical results show various assumptions that students who have high mathematics learning abilities will have an influence on science learning abilities, but other things show that students who have low mathematics learning abilities will not have an influence on science learning abilities.

Furthermore, based on Table 3, the value of student learning outcomes based on the High Science Category (HSC) for the average value of Science learning outcomes is 88.31 while the average value of mathematics learning outcomes is 84.84, while the value of student learning outcomes is based on the Low Science Category (LSC) for the average value of science learning outcomes is 83.58 while the average value of mathematics learning outcomes is 81.96. In looking at the relationship that occurs for the value of student learning outcomes in science and mathematics subjects based on the High Science Category (HSC) and In the Low Science Category (LSC), a statistical test will be used, namely parametric or non-parametric, but before the test is carried out, a prerequisite test is carried out, namely to see whether the data is normally distributed or not, thus showing the test to be carried out next, as for the test results The normality of the data obtained is as follows Table 4.

The relationship between science and mathematics learning outcomes based on HSC and LSC

As seen in Table 4, the average value of student learning outcomes based on the High Category of Science (HSC) for the value of Science Learning Outcomes, it can be concluded that, the value of science learning outcomes based on HSC is not normally distributed with a value of 0.002 because it is less than a significance value of 0, 05, while the average value of student learning outcomes based on the High Science Category (HSC) for the value of Mathematics Learning Outcomes can be concluded that, the value of Mathematics learning outcomes based on HSC is not normally distributed with a value of 0.000 because it is less than a significance value of 0.05. Because the scores for mathematics learning outcomes and science learning outcomes based on HSC are both not normally distributed, a non-parametric statistical test is performed because one or both of these data are not normally distributed. The non-parametric test used to test the relationship between science learning outcomes and science learning outcomes based on the Science High Group category is using the Spearman Test.

Table 4. Normality test based on HSC, LSC

		Unstandardized Residual	Unstandardized Residual	Unstandardized Residual	Unstandardized Residual
N		98	129	98	129
Normal Parameters[a,b]	Mean	0.0000000	0.0000000	0.0000000	0.000000
	Std. Deviation	2.59043504	2.30412708	1.736803	1.988235
Most Extreme Differences	Absolute	0.118	0.236	0.204	0.216
	Positive	0.100	0.236	0.164	0.212
	Negative	-0.118	-0.178	-0.204	-0.261
Test Statistic		0.118	0.236	0.204	0.261
Asymp Sig. (2-talled)		0.002[c]	0.000[c]	0.000[c]	0.000[c]

a. Test distribution is Normal
b. Calculated form data
c. Lilliefors Significance Correction

Then the average value of student learning outcomes based on the Low Science Category (LSC) for the value of Science Learning Outcomes can be concluded that, the value of mathematics learning outcomes based on LSC is not normally distributed with a value of 0.000 because it is less than a significance value of 0.05, while the average the value of student learning outcomes based on the Low Science Category (LSC) for the value of Mathematics Learning Outcomes it can be concluded that, the value of Mathematics learning outcomes based on LSC is not normally distributed with a value of 0.000 because it is less than a significance value of 0.05. Because the scores for mathematics learning outcomes and science learning outcomes based on LSC are both not normally distributed, a non-parametric statistical test is performed because one or both of these data are not normally distributed. The non-parametric test used to test the relationship between science learning outcomes and mathematics learning outcomes based on the Science Low Group (LSC) category is using the Spearman Test.

Based on the HSC and LSC groups, all of them in the normality test were not normally distributed, so as a whole to see the relationship of all of them using the Spearman Test to see the correlation that occurred, while the results of the statistical tests used were as follows.

The results of the correlation test shown in Table 5 shows that the value of students' science and mathematics learning outcomes for the High Science Category (HSC) shows a correlation test value of 0.000 which is smaller than the significance value of 0.05 so that it can be concluded that there is a relationship between the high science learning achievement scores and the Mathematics learning outcomes scores, and the relationship shows a positive relationship which is quite equal to 0.374. However, it is also inversely proportional to the value of students' science and mathematics learning outcomes for the Low Science Category (LSC) showing a correlation test value of 0.170 greater than the significance value of 0.05 so that it can be concluded that there is no relationship between the value of low science learning outcomes and the result value learning Mathematics, and even though the relationship does not show a negative relationship of 0.170.

Table 5. Correlation Test based on HSC and LSC Correlation

			HSC	LSC	Math_HSC	Math_LSC
Spearman 's rho	HSC	Correlation Coefficient	1.000	0.374**	0.028	0.044
		Sig. (2-talled)		0.000	0.785	0.670
		N	98	98	98	98
	LSC	Correlation Coefficient	0.000	1.000	0.199*	0.122
		Sig. (2-talled)	0.280		0.050	0.170
		N	98	129	98	129
	Mth_HSC	Correlation Coefficient	0.28	0.1998	1.000	0.72
		Sig. (2-talled)	0.785	0.050		0.438
		N	98	98	98	98
	Mth_LSC	Correlation Coefficient	0.044	0.122	0.072	1.000
		Sig. (2-talled)	0.670	0.170	0.438	
		N	98	129	98	129

** Correlation is significant at the 0.01 level (2-talled)
*Correlation is significant at the 0.05 level (2-talled)

The meanings obtained from the statistical results show various assumptions that students who have high science learning abilities will have an influence on mathematics learning abilities, but other things show

that students who have low science learning abilities will not have an influence on mathematics learning abilities. If we look at the analysis of the results of the relationship based on the category of either Mathematics or Science, both of them will provide a relationship when student learning outcomes are high but when learning outcomes are low there will not be any relationship. We can see this in the analysis of all students simultaneously between the scores of mathematics learning outcomes and the scores of science learning outcomes.

Table 6. Overall Normality Test Nonparametric Correlations

			KESELURUHAN MTK	KESELURUHAN IPA
Spearman's rho	KESELURUHAN MTK	Correlation Coefficient	1.000	0.479**
		Sig. (2-tailed)		0.000
		N	227	227
	KESELURUHAN IPA	Correlation Coefficient	0.479**	1.000
		Sig. (2-tailed)	0.000	
		N	227	227

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

Relationship between science and mathematics learning outcomes as a whole

As seen in Table 6 the average value of student learning outcomes as a whole for the value of Mathematics Learning Outcomes, it can be concluded that, the value of overall mathematics learning outcomes is not normally distributed with a value of 0.000 because it is smaller than the significance value of 0.05, whereas , the value of science learning outcomes as a whole is not normally distributed with a value of 0.001 because it is smaller than the significance value of 0.05. Because the overall scores for mathematics learning outcomes and science learning outcomes were not normally distributed, a non-parametric statistical test was carried out because one or both of the data were not normally distributed. The non-parametric test used to test the relationship between mathematics learning outcomes and science learning outcomes as a whole uses the Spearman Test.

Based on Table 1, the average value of learning outcomes for mathematics is 83.20 while the average value of learning outcomes for science is 85.62. The Standard Deviation of science learning outcomes is higher than that of Mathematics.

In looking at the relationship that occurs for the value of student learning outcomes in mathematics and science as a whole, a statistical test is carried out that will be used, namely parametric or non-parametric, but before carrying out the test a prerequisite test is carried out, namely to see whether the data is normally distributed or not , thus showing the test to be carried out next, while the data Normality Test results obtained are shown Table 6.

Table 7. Overall Correlation Test One-Sampple Kolmogorov-Smirnov Test

N		Unstandarized Residual	Unstandarized Residual
		227	227
Normal Parameters[a.b]	Mean	0.0000000	0.0000000
	Std. Deviation	2.71422296	2.54401091
Most Extreme Differences	Absolute	0.106	0.084
	Positive	0.106	0.084
	Negative	0.079	0.075
Test Statistic		0.106	0.084
Asymp. Sig. (2-tailed)		0.000[c]	0.001[c]

a. Test Distribution is Normal
b. Calculated from data
c. Lilliefors Significance Correction.

Based on the overall score of learning outcomes in Mathematics and Science learning outcomes to see the relationship that occurs, all of them use the Spearman Test so that there is a correlation or not that occurs, then the statistical test results.

Correlation test results in Table 7 shows that the value of Mathematics and Science learning outcomes shows a correlation test value of 0.000 which is smaller than the significance value of 0.05 so that it can be concluded that there is a relationship between the value of Mathematics learning outcomes and the value of

Science learning outcomes, and the relationship shows a positive relationship that is quite equal to 0.479. The meaning obtained from the statistical results shows various assumptions that students who have the ability to learn Mathematics have an influence on their ability to learn Science (Hillmayr et al., 2020; Li & Schoenfeld, 2019; Maass et al., 2019), and vice versa that students who have the ability to learn Science will have an influence on their ability to learn Mathematics.

Conclusion

Based on the results of the analysis and discussion that have been described in the previous section, several conclusions can be drawn including 1). The overall value of mathematics learning outcomes will have a sufficient influence on the overall value of science learning outcomes and vice versa, 2). The effect of a sufficient relationship in the value of mathematics learning outcomes on science or vice versa occurs when students' learning abilities in mathematics or science are high. 3). There is no influence or relationship in the value of mathematics learning outcomes towards science or vice versa when students' learning abilities in mathematics or science are low. 4) The average descriptive overall mathematics learning result is 83.20 while the average science learning achievement is 85.63, and the science score is higher than the math score. 5). Students who study mathematics will have an influence on learning science, and vice versa students who study mathematics will have an influence on learning mathematics so that these two subjects must be given to students.

Acknowledgments
Place acknowledgments, including information on grants received, before the references, in a separate section, and not as a footnote on the title page.

Author Contribution
This article was compiled based on the author in conducting research conducted quantitatively at SMP 1 Telukjambe Barat, Karawang Regency, class IX, with 227 students in Science and Mathematics subjects by taking their student learning outcomes. The author took survey data on the value of learning outcomes from the cumulative results of the Science and Mathematics learning process which were processed statistically using SPSS version 26. Statistical data analysis was carried out by the author who is also a researcher, to see by testing the relationships that occur accurately data through statistics see the relationship between the two subjects, namely Science and Mathematics.

Funding
This research was conducted by the author independently or not funded by any institution located at SMPN 1 Telukjambe Barat, Karawang Regency in 2023, by taking survey data based on data in the odd semester of 2022.

Conflicts of Interest
The author does not have a conflict of interest in determining the research results, the funder does not play a role in research design, in collecting, analyzing, or interpreting data and in writing the manuscript, nor does the author who is also a researcher have any interests that can influence the interpretation of research results.

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