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Correlation of Self-Regulated Learning and Students' Ability to Solve Mathematical Problems in Algebraic Topics

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ABSTRACT

This study was designed to examine the relationship between self-regulated learning and students' mathematical problem-solving ability among grade VII students at SMP Negeri 9 Surakarta in the 2025/2026 academic year. A quantitative approach with a correlational design was employed. The participants consisted of 89 students selected using cluster random sampling. Data were collected using a mathematical problem-solving test and a self-regulated learning questionnaire. The data were analyzed using descriptive statistics, including mean, median, mode, and standard deviation, followed by assumption testing through normality and linearity tests. Hypothesis testing was conducted using simple correlation and simple linear regression analysis. The analysis satisfied the required assumptions and revealed a positive relationship between self-regulated learning and mathematical problem-solving ability. The results of the simple linear regression analysis indicated that self-regulated learning contributed significantly to students' problem-solving ability, with a significance value of 0.031 and a regression coefficient of 0.408. These findings indicate that students with stronger self-regulated learning skills tend to demonstrate higher effectiveness in solving mathematical problems. The contribution of this study lies in its specific focus on algebraic problem-solving, an area that has received limited empirical attention in relation to self-regulated learning at the junior high school level.

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Introduction

Junior high school grade VII students have entered a formal operational stage that allows abstract thinking and problem-solving (Zuniana & Rahaju, 2019). However, in practice, there are still many students who experience difficulties in learning mathematics, especially algebra and problem solving, and experience high emotional disturbances (Zuniana & Rahaju, 2019).

Education is a planned process that plays a role in the formation of personality according to social values and the development of knowledge, skills, and attitudes that are beneficial to life, as well as being the main foundation in realizing the progress of the nation and the development of individual potential responsibly. Education in Indonesia seeks to develop an understanding of mathematical concepts and the ability to apply them in daily life and problem solving (Nasution, 2022; Sagala, 2022; Ardhani et al., 2025; Dewi & Saharuddin, 2024).

Mathematics is an exact science that is systematically arranged and includes the understanding of numbers, calculations, and logical reasoning related to numbers, space, and shapes, as well as being the basis for various fields of science (Majid et al., 2021; Davita & Pujiastuti, 2020; Leana & Lutfi, 2020). Although it is learned at every level to develop thinking and problem-solving skills, many students still find it difficult (Solikah et al., 2025). Because it is gradual, basic concepts must be mastered before learning advanced material such as algebra, geometry, and trigonometry (Lantakay et al., 2023). In addition to demanding analysis and objectivity, mathematics is used in fields such as architecture and technology, and is a tool for critical thinking in understanding social, economic, and scientific problems, although it is still perceived as a challenging subject (Majid & Amaliah, 2021; Hamdi, 2021; Solikah & Ardhani, 2024). Therefore, good mastery of mathematics is crucial for students to be able to face the challenges of today and the rapid development of technology (Rosyida & Astuti, 2025).

Problem-solving skills are an important competency in mathematics learning because they support analytical reasoning and students' ability to understand the material and solve problems through complex thinking processes (Nailah, 2019; Hanggara et al., 2022; Pratiwi & Alyani, 2022; Suryani et al., 2020; Akuba et al., 2020). However, students' mathematical problem-solving skills in Indonesia are still relatively low, as reflected in the 2022 PISA score of 366 which is below the OECD average and influenced by the mastery of basic skills, interest in mathematics, and students' rational intelligence (Fauziah et al., 2022; Pasha & Aini, 2022). Mathematical problem-solving skills are a systematic thinking process that requires understanding and identifying problems, planning and implementing logical, creative, and efficient solution strategies, accompanied by evaluation of results, so as to reflect logical, analytical, and innovative thinking skills in facing various challenges (Febriyanti & Irawan, 2023; Thayeb & Putri, 2019; Ristanty & Primary, 2022; Usman et al., 2022). Students' ability to solve math problems in mathematics learning is closely related to learning independence, where various studies show that high levels of self-regulated learning have a positive and significant relationship to student learning outcomes (Pohan et al., 2023).

The mathematical skills of SMP Negeri 9 Surakarta students still need to be improved through more varied learning because teacher-centered learning causes some students to be less focused, passive, and reluctant to ask questions even though they experience difficulties, which has an impact on the low ability to solve mathematical problems of grade VII students as reflected in the results of the mid-semester assessment where only 24 out of 287 students achieved the criteria for achieving learning objectives, and shows that self-regulated learning is one of the factors that play a role in these conditions (Dewi et al., 2020).

Self-regulated learning is an important ability that allows students to plan, manage, and implement learning strategies appropriately through metacognitive, motivational, and behavioral settings, so that students can be actively involved, maintain motivation, and be responsible for the process and achievement of their learning goals (Hikmah, 2021; Fazriah, 2019; Khairunisa, 2021) . The indicators of Pasha & Aini (2022) self-regulated learning according to include the ability to diagnose learning needs, monitor and manage the learning process, choose and implement appropriate strategies, and evaluate learning processes and outcomes. Self-regulated learning is an individual's skill in managing and controlling the learning process consciously through metacognitive, motivational, and behavioral settings, including the ability to plan, monitor, and evaluate learning in the face of academic demands

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and difficulties (Nailah, 2019; Fazriah, 2019). This ability allows students to manage their time and learning strategies appropriately, be responsible for their learning outcomes, and achieve learning goals effectively and independently (Sibuea et al., 2022).

Various previous studies have discussed self-regulated learning in a number of contexts. A study conducted by Fazriah (2019) indicates a good and relevant correlation between students' independence ability and achievement in chemistry learning. Rosia (2021) in her research found that the application of independence correlates with student learning motivation. In addition, research by Nurhikmah (2021) stated that there is a relationship between independence and academic flow during online lesson activities. Although these findings focus on self-regulated learning, there has been no study of the correlation between self-regulated learning and math problem-solving ability. Researchers view self-regulated learning as a major factor that contributes to student learning success. Based on various obstacles related to learning independence and the skills to solve mathematical obstacles found in schools, the researcher felt the need to conduct further research. Thus, this study is directed at whether there is a relationship between self-regulated learning and the ability to solve mathematical problems in grade VII students of SMP Negeri 9 Surakarta for the 2025/2026 Academic Year.

Method

Research Type and Subject

This study applied a quantitative approach with a correlational model to examine the statistical relationship between *self-regulated learning* and the ability of SMP Negeri 9 Surakarta students to solve mathematical problems. The research population involved all 287 students in grade VII, and the sample was taken using *cluster random sampling* resulting in three classes with a total of 89 students. Information was collected through math problem-solving skills tests as well as questionnaires on *self-regulated learning*. The researcher also interviews the mathematics teacher with an interview role model and after that the results will be presented by the researcher.

Instruments

Researchers used problem-solving tests such as "a farmer harvested 4 sacks of rice and 6 sacks of corn, with a total weight of 152 kg. If the weight of one sack of rice is x kg and one sack of corn is y kg and the weight of one sack of rice is 3 kg heavier than one sack of corn, determine the weight of each?" and *self-regulated learning questionnaires* such as "I set a goal, learn the material to be taught before being taught by the teacher". The test is carried out to obtain how far the level of ability to solve mathematical problems and questionnaires are carried out to obtain variable *self-regulated learning*. Both instruments were arranged according to relevant indicators and have been tested for validity and reliability using the SPSS Version 25 application.

Table 1. *Self-Regulated Learning Instruments*

Indicator	Statement		Validity test	
	Positive	Negatives	Valid	Invalid
Diagnosing Learning Needs	1,2,3,4	5,6,7,8	4,6,8	1,2,3,5,7
Acquiring Learning Needs	9,10,11,12	13,14,15,16	10,12,14,15,	9,11,13,16,
Monitoring, Organizing and Controlling the Learning Process	17,18,19,20	21,22,23,24	17,19,20,21,22,23,24	18

Indicator	Statement		Validity test	
	Positive	Negatives	Valid	Invalid
Choosing and Implementing Learning Strategies	25,26,27,28	29,30,31,32	25,28,31,32	26,27,29,30
Evaluating the Learning Process and Outcomes	33,34,35	37,38,39,40	33,34,35,36,37,40	38,39

The *self-regulated learning* instrument consists of 40 questions on a Likert scale and uses 5 indicators from Pasha & Aini (2022).

Table 2. Mathematical Problem-Solving Ability Instrument

Indicator	Number of Questions	Question Form	Validity Test	
			Valid	Invalid
Diagnosing the Available Information	10	Essay	10 Valid Questions	-
Confusing in the Form of Mathematics	10	Essay	10 Valid Questions	-
Using Settlement Strategies	10	Essay	10 Valid Questions	-
Interpreting the Outcome of the Settlement	10	Essay	10 Valid Questions	-

The instrument of mathematical problem solving consists of 10 questions, where each question has a question item from a-d and uses an indicator of Usman et al (2022).

Table 3. Reliability Test

Variabel	Reliability	
	Crombach's Alpha	N
Self-Regulated Learning	0,843	40
Ability to solve math problems	0,891	40

The reliability test using *Crombach's alpha* obtained a result of 0.843 for *self-regulated learning* and 0.891 for the ability to solve mathematical problems, a high level of reliability and appropriate for research.

Data Collection

Data was collected using two research methods, namely questionnaire distribution and test work. The collection of the trial is a test of 10 questions with items a-d and a questionnaire of 40 questions. After conducting a validity and reliability test, the researcher determined 5 test questions and 24 questionnaire questions to be conducted. The questionnaire was conducted to measure the level of *self-regulated learning* variables that have been verified and have appropriate validity and reliability. In addition, tests are carried out to obtain results in the ability to solve mathematical problems.

Data Analysis

This study uses quantitative research with a correlational approach. The correlational approach was carried out to find out whether there is a correlation between *self-regulated learning* and students' ability to solve mathematical problems. It was then processed with various analysis techniques such as calculating means, medians, most frequent values, and standard deviations; condition analysis examination including normality tests and linearity tests; and hypothesis testing through correlation analysis and simple regression analysis methods used as methods supporting analysis.

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Research Findings

Self-Regulated Leraning (SRL)

Research findings related to *self-regulated learning* variable Y show that the highest questionnaire score reached 113, while the lowest score was 67. The average score was 88.28 with a standard deviation of 9.982. The data can then be visualized through a diagram as shown below.

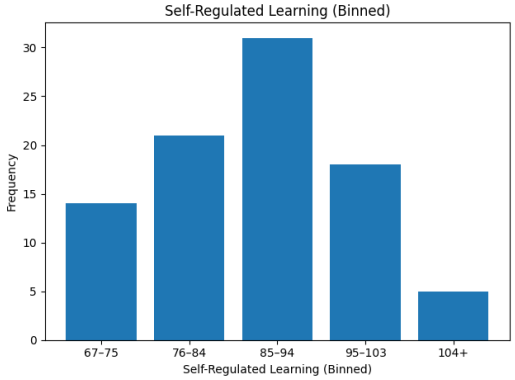

Figure 1. Bar Diagram of Self-Regulated Learning

Table 4. SRL Frequency Distribution

Test Results	Frequency
67-75	14
76-84	21
85-94	31
95-103	18
104-113	5
Total	89

Mathematical Problem-Solving Skills (KPMM)

This finding related to variable Y shows that the highest test score reaches 100, while the lowest score is 23. The average score is 71.30 with a standard deviation of 21.902. The data can then be visualized through a diagram as shown below.

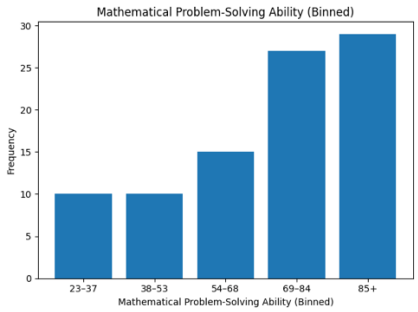

Figure 2. Bar Diagram of Mathematical Problem Solving Ability

Table 5. KPMM Frequency Distribution

Test Results	Frequency
23-37	10
38-53	10
54-68	14
69-84	27
85-100	28
Total	89

The study was conducted with grade VII students of SMP N 9 Surakarta who had received learning algebra material. The number of samples was 89 grade VII students in the 2025/2026 odd semester school year. The main purpose of this study is to find out the correlation between *self-regulated learning* and problems solving mathematics problems in grade VII students. Quantitative research with correlational analysis techniques, which is a statistical analysis method that assesses the relationship between several variables. Data on the level of *self-regulated learning* and the ability to solve mathematical problems were carried out through *questionnaires* and tests. The data were processed to show the correlation between *self-regulated learning* and the ability to solve mathematical problems in grade VII students.

Table 6. Descriptive Data

Name	N	Min	Max	Mean	SD
SRL	89	67	113	88,28	9,982
KPMM	89	23	100	71,30	21,902
Total	89				

Data Analysis Prerequisites Test

Test normality is a statistical procedure carried out in assessing whether a data has a distribution that is close to the normal curve. The data is said to be normal if the significance value > 0.05, and vice versa. According to Arikunto (2013)

Table 7. Normality Test

Name	Say.	Test Results	Ket.
SRL	0,200	$> \alpha$	Normal
KPMM	0,250	$> \alpha$	Normal

The linearity test aims to see the two relevant lime-correlated variables.

Table 8. Linearity Test

Name	Say.	Test Results	Ket.
Linearity	0,041	$< \alpha$	Linear
Deviation from Linearity	0,347	$> \alpha$	Linear

Uji Hypothesis

Product Moment Correlation Pearson assesses the correlation between two variables, an interval or ratio. The results of data processing resulted in a relationship between (Budiwanto, 2019) *self-regulated learning* and the ability to solve mathematical problems, as presented below.

Table 9. Correlation Test

Name	*Person Corelation*	Say.	α	Test Results
SRL	0,186	0,041	<	Correlated
KPMM	0,186	0,041	<	Correlated

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The table shows that there is a correlation between *self-regulated learning* and problem-solving ability, where the pattern appears indicates that the two variables have a positive relationship.

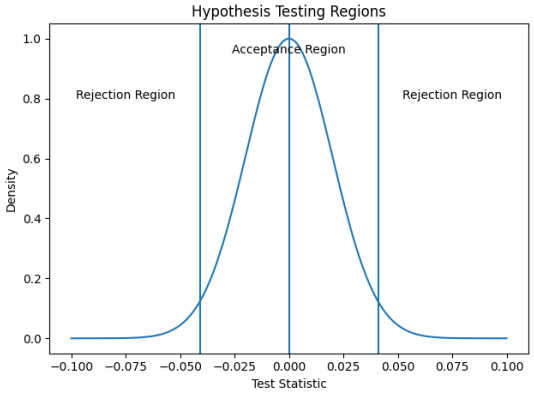

Figure 3. Critical Areas

H_0 = There was no correlation between *self-regulated learning* and students' math anxiety.
H_1 = there is a correlation between *self-regulated learning* and students' math anxiety.

Simple Linear Regression Test

Analysis is used to see the influence of these variables. This was applied to assess the influence of *self-regulated learning* on mathematical problem-solving skills, so that the extent of change in the two variables can be seen.

Table 10. Simple Linear Regression Test

Name	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	33,324	20,535		1.720	0,089
SRL	0,408	0,231	0,0186	1.763	0,031

With simple linear regression test equations, it is obtained.

$$Y = 35{,}324(X) + 0{,}408 + e$$

The constant of 35.324 indicates that *self-regulated learning* is fixed, so the value of the ability to solve mathematical problems is 35.324. In addition, the regression coefficient (β) is 0.408 which indicates that every increase in *the value of self-regulated learning* that increases by one unit will increase the ability to solve mathematical problems by 0.408. With significance values of 0.031 < 0.05 and (1.763) (1.663), the findings confirm that $t_{hitung} > t_{tabel}$*self-regulated learning* contributes positively and is relevant in the addition of mathematical problem-solving skills. Thus, the level of *self-regulated learning* will improve the skills of solving mathematical problems.

Discussion

The purpose of this finding to examine the correlation between *self-regulated learning* and students' ability to solve mathematical problems is that there is a relevant relationship between the two variables, which states that if students have mathematical problems, they can be solved by *self-regulated learning.* Also, it is emphasized by the product moment correlation

test and simple linear regression. The results of the Pearson test showed a significant correlation between the two variables with a significance value of 0.041, which indicates that *self-regulated learning* is directly proportional to students' ability to solve math problems. This finding was strengthened by regression analysis showing the positive influence of *self-regulated learning* (X) on problem-solving ability (Y), evidenced by a significance value of 0.031 < 0.05 and a regression coefficient of 0.408, which means that an increase of one unit in *self-regulated learning* has the potential to increase students' ability to solve mathematical problems by 0.408.

Various studies show that self-regulated learning plays an important role and has a positive relationship with mathematical problem-solving skills, because good learning independence encourages students to manage metacognitive, motivational, and behavioral aspects effectively to achieve learning goals (Saifullah, 2024; Dewi et al., 2020; Sibuea et al., 2022; Fazriah, 2019; Hikmah, 2021). However, there are still many students who experience difficulties in learning mathematics, especially algebra and problem solving, so it is necessary to develop problem-solving skills as a structured thinking process that involves understanding problems, choosing the right strategies, and solving logically and creatively (Zuniana & Raju, 2019; Febriyanti & Irawan, 2023). This ability is important to develop because it supports high-level reasoning, helps to deal with various learning challenges, and can be applied in various life contexts (Pasha & Aini, 2022; Nailah, 2019; Akuba et al., 2020; Hanggara, 2020).

The findings strengthen the understanding that when students are able to plan, monitor, and evaluate their learning process well, their skills in dealing with and solving math problems will develop optimally. Thus, *self-regulated learning* can be seen as an important factor that plays a role in increasing the effectiveness of mathematics during learning and has a positive impact on students' overall academic abilities. Another factor that is an important factor for solving math problems is *seft-afficacy*.

Conclusion

This study concludes that *self-regulated learning* has a positive and significant relationship with the mathematical problem-solving ability of grade VII students of SMP Negeri 9 Surakarta in algebraic materials, based on correlation analysis supported by simple linear regression as a relationship support analysis. These findings are limited to the scope of grade VII and algebraic materials and use correlational designs and non-observational instruments, so the results cannot be generalized widely. Therefore, further research is recommended using experimental design or expanding the context of the material and the subject of the research, while for education practitioners, these results can be taken into consideration in designing mathematics learning that supports the development of *students'* self-regulated learning.

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Conflict of Interest

The researcher revealed that there was no conflict interest.

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Authors' Contributions

N.H.S knows all the main ideas listed above. The second author, W.A, is the supervisor in this research, actively contributing and contributing to the writing of this article. All authors reveal the final article that has been read and approved. The total percentage of contribution of this study is as follows: N.H.S 60% and W.A 40%.

Data Availability Statement

The authors declare that the data supporting the findings of this study will be made available by the corresponding author, N.H.S., upon reasonable request.

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