

THE RELATIONSHIP BETWEEN MATHEMATICAL DISPOSITION AND SELF-REGULATED LEARNING TO MATHEMATICAL PROBLEM-SOLVING ABILITY

Nida Firdaus^{1*}, Rika Sukmawati², Warsito³

^{1,2,3} Program Studi Pendidikan Matematika, Universitas Muhammadiyah Tangerang, Indonesia

* Corresponding author. Jl. Perintis Kemerdekaan 1/33, 15118, Cikokol, Kota Tangerang, Indonesia.

E-mail: nida@umt.ac.id¹
rikasukmawati35@gmail.com²
warsito@umt.ac.id^{3*}

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ABSTRACT

Problem-solving skills are one of the important competencies that students need to have, but they are still influenced by various factors such as mathematical disposition and self-regulated learning. This study aims to determine the relationship between mathematical disposition and self-regulated learning to mathematical problem-solving ability. The research uses a quantitative approach with a correlational method. The research sample consisted of 71 Grade VII students who were determined using the Slovin Formula and selected using the Proportionate Stratified Random Sampling technique. Data collection was carried out through a mathematical disposition questionnaire, a self-regulated learning questionnaire and a mathematical problem-solving ability test. Data analysis uses Pearson correlation, multiple correlation, and multiple linear regression analysis. The results showed that mathematical disposition had a positive relationship with a low relationship rate with mathematical problem-solving ability with a correlation value of 0.361. Self-regulated learning has a positive relationship with a low relationship level with mathematical problem-solving ability with a correlation value of 0.311. Together, mathematical disposition and self-regulated learning had a positive relationship with a low relationship rate on mathematical problem-solving ability with a correlation value of 0.371 and a contribution of 13.7%. The results of this study show that mathematical problem-solving ability is influenced by various factors other than mathematical disposition and self-regulated learning.

Keywords: mathematical disposition; mathematical problem-solving; self-regulated learning.

ABSTRAK

Kemampuan pemecahan masalah merupakan salah satu kompetensi penting yang perlu dimiliki siswa, namun masih dipengaruhi oleh berbagai faktor seperti disposisi matematis dan kemandirian belajar. Penelitian ini bertujuan untuk mengetahui hubungan disposisi matematis dan kemandirian belajar terhadap kemampuan pemecahan masalah matematis. Penelitian menggunakan pendekatan kuantitatif dengan metode korelasional. Sampel penelitian berjumlah 71 siswa kelas VII yang ditentukan menggunakan Rumus Slovin dan dipilih melalui teknik Proporsionate Stratified Random Sampling. Pengambilan data dilakukan melalui angket disposisi matematis, angket kemandirian belajar dan tes kemampuan pemecahan masalah matematis. Analisis data menggunakan korelasi Pearson, korelasi berganda, dan analisis regresi linier berganda. Hasil penelitian menunjukkan disposisi matematis memiliki hubungan positif dengan tingkat hubungan rendah terhadap kemampuan pemecahan masalah matematis dengan nilai korelasi sebesar 0,361. Kemandirian belajar memiliki hubungan dengan positif dengan tingkat hubungan rendah terhadap kemampuan pemecahan masalah matematis dengan nilai korelasi sebesar 0,311. Secara bersama-sama, disposisi matematis dan kemandirian belajar memiliki hubungan positif dengan tingkat hubungan rendah terhadap kemampuan pemecahan masalah matematis dengan nilai korelasi sebesar 0,371 dan kontribusi sebesar 13,7%. Hasil penelitian ini menunjukkan kemampuan pemecahan masalah matematis dipengaruhi oleh berbagai faktor selain disposisi matematis dan kemandirian belajar.

Kata kunci: disposisi matematis; kemampuan pemecahan masalah matematis; kemandirian belajar.



Introduction

Problem-solving skills are one of the main components that students must possess and have an important role in solving problems in daily life. According to the *National Council of Teachers of Mathematics* (NCTM), problem-solving skills are one of the five main components that students must master in the mathematics learning process (Az-Zahra et al., 2025). In mathematics learning, problem-solving skills train students to develop their thinking (Lasdianto et al., 2023) so that students are indispensable in overcoming complex challenges in daily life (Fadhilla & Afri, 2024)

Students' mathematical problem-solving skills based on findings in the field are still relatively low. The results of the initial observation showed that students had difficulties in solving mathematical problems in the form of stories that were not similar to the examples given, especially at the stage of determining the completion steps. The inability of students to formulate completion steps will have an impact on the next stage (Amalina & Vidákovich, 2023). Problem-solving-based learning encourages students to construct their own knowledge, develop reasoning skills, and improve learning outcomes through systematic mathematical problem-solving activities (Vahlia & Agustina, 2016). This condition shows that mathematical problem-solving skills need attention. In line with previous research that showed that students' mathematical problem-solving skills were in the low category (Ditasari et al., 2024; Hafizah et al., 2025). This is strengthened by the results of an evaluation by PISA (Programme for International Student Assessment) in 2022 Indonesia is ranked 68 out of 81 countries with a mathematics score of 379 (Suyanto & Jihad, 2025). This achievement shows that most students are not able to solve problems that require reasoning and problem-solving in real-life contexts (Mashuri & Jahring, 2023). The Creative Problem Solving model significantly improves students' learning creativity by actively engaging them in solving mathematical problems, indicating the importance of positive learning dispositions in mathematics learning (Oktaviana et al., 2017). Students' mathematical problem-solving processes differ according to their learning styles, indicating that individual learning characteristics influence conceptual, procedural, and technical stages of problem solving (Ningrum et al., 2025). The ability to solve mathematical problems does not only depend on cognitive ability, but there are also other factors such as increasing a positive attitude towards mathematics or called mathematical disposition (Rezita & Rahmat, 2022; Riswanti, 2022) and self-regulated learning (Ambiyar et al., 2020; Nurdiati et al., 2024).

Mathematical disposition shows an attitude of confidence, independence, resilience, and can achieve the expected goals so that it becomes an important component in mathematics learning. According to NCTM (2000), mathematical disposition shows a tendency to have a positive attitude towards mathematics such as confidence, diligence, curiosity and flexibility in thinking (Hifziyati et al., 2025) Mathematical disposition helps students in having a positive, independent, resilient, and enthusiastic attitude in solving mathematical problems (Mustika, 2024) and

make students enjoy learning activities so that the desired learning goals can be achieved (Nur et al., 2024) and play an important role in making decisions and responsibilities in solving problems (Riskon et al., 2021). Conceptually, the characteristics of mathematical disposition that students possess such as confidence, perseverance, flexibility in thinking and curiosity can encourage students to understand problems better, devise appropriate solution strategies, implement strategies consistently, and re-evaluate the results obtained (Ali & M, 2024)

Self-regulated learning reflects an attitude of initiative, analyzing learning needs, setting strategies in the learning process and seeing difficulties as challenges to master a competency or final goal. Self-regulated learning has an important role in learning where students have the freedom and responsibility to manage their learning process to achieve the goals they have set (Göller et al., 2024) through self-encouragement in constructing, defining, knowledge, and efforts to improve students' abilities and achievements both inside and outside school (Warsito & Saleh, 2021) so that they form an attitude of independence, confidence and are able to control themselves (Anggraeni & Eva, 2024) and encourage students to overcome problems in the learning process (Annisa & Liberna, 2025). In mathematics learning, self-regulated learning plays a role in supporting students' mathematical problem-solving skills to manage the learning process systematically. The process includes planning, implementation, monitoring, reflection and evaluation, as well as adjusting learning strategies so that students can choose and improve solving strategies independently that support their ability to solve mathematical problems (Noor et al., 2025).

Based on the description of the theory, mathematical disposition and self-regulated learning are conceptually related to mathematical problem-solving skills. Mathematical disposition encourages students to remain confident, diligent, and flexible in dealing with math problems, while self-regulated learning helps students manage their learning process through planning, monitoring, and evaluation of problem solving. Therefore, the two variables are suspected to complement each other in supporting students' ability to solve mathematical problems effectively.

Previous research results show that there is a positive and significant relationship between mathematical disposition and mathematical problem-solving ability (Lomri & Dasari, 2024; Rezita & Rahmat, 2022; Riswanti, 2022). Other research shows that there is a significant relationship between self-regulated learning and mathematical problem-solving skills (Sulistiyani et al., 2020). In line with research conducted by Alya et al., it shows that there is a fairly strong relationship between self-regulated learning and problem-solving skills (Suryana et al., 2024). Based on the results of the study of these studies, previous studies have examined the relationship between each variable separately (Lomri & Dasari, 2024; Rezita & Rahmat, 2022; Sulistiyani et al., 2020; Suryana et al., 2024). Therefore, research examining the relationship between mathematical disposition and self-regulated learning on mathematical problem-solving ability is still limited.

Based on this description, this study aims to analyze the relationship between mathematical disposition and self-regulated learning together to mathematical problem-solving ability so that it is expected to provide a more comprehensive picture of the relationship between the two variables as a basis for consideration for

teachers in developing mathematics learning strategies that support the improvement of students' mathematical problem-solving skills.

Research Methods

Types and approaches of research

This study uses a quantitative approach with a correlational design. According to Sugiyono, the quantitative approach is research based on the philosophy of positivism to research certain populations or samples by collecting data using instruments, statistical data analysis (Balaka, 2022). The correlational design is used to measure the direction and strength of the relationship between variables without directly manipulating the research subject (Rangkuti & Albina, 2025)

Population and sample

The population of this study is all grade VII students of SMPN 3 Panongan for the 2025/2026 school year with a total of 244 students who have obtained material in accordance with the research instruments. The number of samples to be studied is determined using the Slovin Formula to determine the number of representative samples and the results of the study can be generalized to the population efficiently by considering an error rate of $\alpha = 10\%$. The use of the error rate takes into account the characteristics of the relatively homogeneous population as well as the limitations of time and access in the data collection process so that the number of samples required is 71 students. The sampling technique uses Proportionate Stratified Random Sampling to determine the sample needed in each class proportionally and randomly without considering differences in academic or other abilities.

Research variables

The variables in this study were measured using questionnaires and tests. The questionnaire instrument was used to measure the variables of mathematical disposition compiled based on indicators that had been determined by referring to NCTM's opinion including 1) confidence; 2) curiosity in mathematics; 3) diligence in solving mathematical problems; 4) Flexible; 5) reflect and observe the results of work on the way of thinking; 6) appreciate the application of mathematics in daily life; and 7) appreciating the role of mathematics (Astriani & Dhana, 2025) and self-regulated learning instruments are prepared based on indicators that have been determined by referring to sugandi's opinion including 1) initiative; 2) examine learning needs; 3) implementing learning objectives; 4) monitor, regulate, and control the learning process; 5) difficulties as challenges; 6) finding and utilizing learning resources; 7) learning strategies; 8) evaluation of learning processes and outcomes; and 9) self concept (Ghassani et al., 2023). Meanwhile, the test is used to measure mathematical problem-solving skills based on the Polya indicator, including 1) understanding problems; 2) plan the problem; 3) implement the settlement plan; and 4) re-examining the process and results (Rosidah & Parta, 2022).

Data Collection Techniques

The data collection technique of mathematical disposition and self-regulated learning used a questionnaire with a likert scale model with 4 alternative answers, namely SA (Strongly Agree), A (Agree), D (Disagree), and SD (Strongly Disagree). Meanwhile, the data collection technique for mathematical problem-solving skills uses description questions.

Validity and reliability of the instrument

Before conducting the research, the instrument used conducts a validity and reliability test first through a content validity test to assess the suitability of the indicators with the measured construct, the clarity of the redaction of each item, and the suitability of the language used which is carried out by expert judgment, namely by lecturers who have expertise in the field of mathematics education. In addition, trials were also carried out on students who had similar characteristics to the research sample. The validity of the instrument was analyzed using the Pearson Product moment correlation, while the reliability of the instrument was analyzed using Cronbach's Alpha coefficient.

The results of the validity test of the 30 statements in the mathematical disposition questionnaire contained 28 valid statements and 2 invalid statements. In the self-regulated learning questionnaire, 30 valid statements and 2 invalid statements were obtained from 32 statements. Meanwhile, the mathematical problem-solving ability test questions from 5 questions were obtained with 4 valid questions and 1 invalid question. Based on the analysis of reliability data, the reliability value of the mathematical disposition questionnaire was $r = 0.885$, the reliability value of the self-regulated learning questionnaire was $r = 0.842$, and the reliability value of the mathematical problem-solving ability test was $r = 0.883$. All three instruments have a reliability correlation in high criteria, so the instrument is declared reliable.

Data analysis techniques

The data analysis technique in this study uses correlation analysis to determine the relationship between variables by using the total score on each variable. Before the correlation test is carried out, the classical assumption test is carried out. After the classical assumption test was met, a simple correlation test was performed to determine the relationship between independent variables and bound variables using Product Moment correlation, multiple correlation tests to determine the relationship between independent variables together with bound variables, and multiple linear regression analysis to determine the contribution of mathematical disposition and self-regulated learning to mathematical problem-solving ability. Data analysis using IBM SPSS Statistic 25 software. The interpretation of the relationship level is based on the value of the correlation coefficient as follows in Table 1.

Table 1. Relationship Level Interpretation Guidelines

Category	Relationship Level
0,00 – 0,199	Very Low
0,20 – 0,399	Low
0,40 – 0,599	Medium
0,60 – 0,799	Strong
0,80 – 0,100	Very Powerful

Results and Discussion

The data from the research results were obtained based on three variables, namely mathematical disposition (X_1), self-regulated learning (X_2) and mathematical problem-solving ability (Y). Based on the results of the study, descriptive statistical data on the variables of mathematical disposition, self-regulated learning, and mathematical problem-solving ability were obtained as presented in Table 2 below.

Table 2. Descriptive Statistics.

	Mathematical Disposition	Self-Regulated Learning	Mathematical Problem-Solving Skills
N	71	71	71
Minimum	56	47	10,94
Maksimum	99	106	46,88
Mean	80,80	84,46	21,744
Std. Deviation	10,403	11,295	8,401

Based on table 2, the average mathematical disposition is 80.80 with a high score of 99 and a low of 56. The average self-regulated learning was 84.46 with the highest score of 106 and the lowest score of 47. Meanwhile, mathematical problem-solving ability has a maximum score of 46.88 and a minimum of 10.94 with an average of 21.744.

Normality tests are performed on each variable using the Kolmogorov-Smirnov to ensure that the simple correlation test used meets the normality assumption. The test results show that the mathematical disposition has a sig value. $0.059 > 0.05$ shows normally distributed data. Self-regulated learning has a value of $0.200 > 0.05$, indicating normally distributed data and mathematical problem-solving ability to have niali sig. $0.073 > 0.05$ indicate normally distributed data.

The normality test was also carried out on the residual value of regression as one of the prerequisites for multiple correlation analysis. The normality test of residual values used Kolmogorov-Smirnov. The results of the analysis showed that the research data was normally distributed which showed the value of sig. $0.055 > 0.05$.

The results of the linearity test between the X_1 and Y variables showed a Sig value. Deviation from linearity of $0.703 > 0.05$ showed linearity. Between the X_2 and Y variables the Sig. Deviation Linearity value is $0.962 > 0.05$ indicates linear. So the relationship between variables meets the assumption of linearity.

The results of the multicollinearity test showed a Tolerance of $0.522 > 0.1$ and a VIF value of $1.916 > 10$. Therefore, there is no multicollinearity between independent variables in this study.

The results of the heteroscedasticity test showed that the significance value of the X_1 variable was $0.437 > 0.05$ indicating that heteroscedasticity did not occur. In the X_2 variable, the value of sig. $0.394 > 0.05$ indicate that heteroscedasticity does not occur. Thus, the regression moel does not experience heteroscedasticity.

A simple correlation test was performed to analyze the relationships between variables using the Pearson Product Moment correlation test. The results of the simple correlation test are presented in the following Table 3.

Table 3. Simple Correlation Test.

Variabel	Pearson Correlation	Significance
X_1 with Y	0,361	0,002
X_2 with Y	0,311	0,008
X_1 with X_2	0,692	0,000

Based on table 3, the significance value of X_1 with Y is $0.002 < 0.05$ then H_1 is accepted which shows that there is a relationship between mathematical disposition and mathematical problem-solving ability. The level of relationship is seen at the Pearson Correlation value of 0.361, indicating that there is a positive relationship with a low level of relationship.

These findings suggest that students who have better mathematical dispositions tend to have better mathematical problem-solving skills despite the low relationships formed. This finding measures the mathematical disposition as a single construct so it cannot show the most dominant aspect. Theoretically, aspects of mathematical disposition related to confidence, toughness, independence and perseverance so as to help students survive when understanding problems and finding solution strategies, in addition to flexibility in thinking allows students to try various alternative strategies and curiosity, optimism encourages students to re-examine the results of the solution according to the stages of problem solving (Hifziyati et al., 2025; Mustika, 2024).

This finding is different from previous research that states that there is a relationship between mathematical disposition and mathematical problem-solving ability which is in the strong category (Lomri & Dasari, 2024; Rezita & Rahmat, 2022; Riswanti, 2022). The differences in the degree of relationships that occur indicate that the contribution of mathematical dispositions to students' mathematical problem-solving abilities may vary in different research contexts such as in the learning environment used. The variation in students' initial math abilities can affect students' success in solving mathematical problems (Amalina & Vidákovich, 2023). In addition, students' working memory also contributes to students' mathematical problem-solving abilities (Ji & Guo, 2023). Thus, mathematical disposition is not the only factor that contributes to a student's ability to solve mathematical problems.

Furthermore, based on the results of the study, the significance value of X_2 with Y was $0.008 < 0.05$, H_2 was accepted, which showed that there was a relationship between self-regulated learning and mathematical problem-solving ability. From the results of the calculation, the Pearson Correlation value of 0.311 was obtained, indicating that there was a positive correlation with a low level of relationship.

These findings show that students with good aptitude tend to have good mathematical problem-solving skills even though they are in the low category. Self-regulated learning has a role in managing the learning process systematically so as to support students' mathematical problem-solving abilities through planning, implementation, monitoring, reflection and evaluation, as well as adjusting learning strategies that support each stage of problem-solving according to Polya (Noor et al., 2025). Self-regulated learning allows students to be more active in achieving their desired goals by organizing the learning process independently and in a directed manner (Göller et al., 2024). Self-regulated learning can overcome problems faced during the learning process (Annisa & Liberna, 2025). In addition, an attitude of independence, confidence, and being able to control themselves will be formed in students (Anggraeni & Eva, 2024). This ability helps students to understand and solve mathematical problems in a more targeted manner.

The findings of this study are different from previous research which showed that there is a positive relationship between self-regulated learning and students' mathematical problem-solving ability and sufficient category (Suryana et al., 2024). Meanwhile, other studies show that the relationship is in a strong category (Sulistiyani et al., 2020). The difference in findings is suspected to be caused by differences in the characteristics of the respondents, as well as the learning environment used. These findings show that the ability to manage the learning process independently is not necessarily followed by high mathematical problem-solving skills. This indicates that mathematical problem-solving skills not only require independent learning, but are also supported by the habit of working on non-routine problems, and affective factors include interest, motivation, pressure, and anxiety (Aulina et al., 2025). In addition, the ability to think reflexively and requires various thought processes can improve mathematical problem-solving skills (Syadid & Sutiarmo, 2021). Thus, self-regulated learning can be a supporting factor in determining students' mathematical problem-solving abilities.

The results of the analysis also showed a strong positive relationship between mathematical disposition and self-regulated learning with a correlation coefficient of 0.692. This shows that students who have a mathematical disposition and self-regulated learning have a positive attitude towards mathematics tend to be more able to manage their learning process independently. Confidence, perseverance and flexibility of thinking as components of mathematical disposition (Hifziyati et al., 2025) can encourage students to set learning goals, monitor the learning process and evaluate learning outcomes (Noor et al., 2025).

Hasil pengujian korelasi berganda dilakukan untuk menganalisis hubungan antar variabel secara bersama-sama disajikan pada Tabel 4.

Table 4. Multiple Correlation Test

Model	R	R square	Sig. F change
1	0,371	0.137	0.007

Based on table 4, the value of Sig. F change is $0.007 < 0.05$ then H_3 is accepted which shows that there is a relationship between mathematical disposition and self-regulated learning to mathematical problem-solving ability. A multiple correlation value (R) of 0.371 indicates that mathematical disposition and self-regulated learning together have a positive relationship with a low relationship rate with mathematical problem-solving ability. The R square value of 0.137 indicates that mathematical disposition and self-regulated learning have a contribution of 13.7% to mathematical problem-solving ability while the remaining 86.3% is influenced by other factors outside this study.

The positive relationship obtained showed that mathematical disposition and self-regulated learning have a role in supporting students' ability to solve mathematical problems. Mathematical disposition as one of the affective aspects in mathematics learning reflects a tendency towards positive attitudes towards mathematics, confidence, flexibility in thinking, independence, diligence, and curiosity (Hifziyati et al., 2025; Rezita & Rahmat, 2022). Meanwhile, self-regulated learning helps students improve their abilities and achievements that come from within themselves (Warsito & Saleh, 2021).

The low strength of relationships and contribution of 13.7% obtained showed that mathematical disposition and self-regulated learning were not the only factors related to mathematical problem-solving ability. According to Santos-Trigo (2024), mathematical problem-solving skills involve various interrelated mathematical processes from formulation to problem solving (Santos-Trigo, 2024). In addition, self-efficacy, math anxiety, and student background are factors in mathematical problem-solving ability (Xu & Qi, 2022). These findings show that mathematical disposition as an affective aspect and self-regulated learning have a relationship that can be seen as a factor that supports students' mathematical problem-solving ability. The results of this study can also be influenced by school characteristics, learning culture, teacher learning strategies, the availability of learning facilities, and different learning environments (OECD, 2023)

These findings suggest that positive attitudes towards mathematics and self-regulated learning have contributed to mathematical problem-solving skills, but are not the only factors that play a role. Therefore, teachers can design the learning process through activities that provide opportunities for students to plan completion strategies, monitor the thinking process, and reflect on the results obtained. In addition, teachers can foster mathematical disposition through giving challenges, strengthening confidence, and getting used to flexible thinking. Self-regulated learning is fostered through guiding students in setting goals, planning the completion process, and evaluating learning outcomes. As well as training mathematical thinking skills so that students' ability to solve mathematical problems can develop optimally.

Conclusion and Suggestion

The results showed that mathematical disposition and self-regulated learning were related to the low category of mathematical problem-solving skills. These findings indicate that mathematical disposition and self-regulated learning play a role in mathematical problem-solving ability, although they are not yet dominant factors. The results of this study reinforce that mathematical problem-solving ability is influenced by various factors, not only mathematical disposition and self-regulated learning.

Practically, teachers need to pay attention to other factors that support mathematical problem-solving skills such as mastery of concepts, learning motivation and the right learning strategies. This research is still limited in the number of variables and characteristics of the research subjects so that the results of the research cannot be generalized widely. Therefore, further research is recommended to use Structural Equation Modeling (SEM) or Partial Least Squares Structural Equation Modeling (PLS-SEM) by involving other relevant variables and a more diverse sample in order to obtain a more complex relationship between variables.

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