

Student Learning Independence and Mathematical Problem-Solving Skills

Natiqotul Khoeriyah^{1*}, Nurimani¹, Erlis Warti¹

¹Mathematics Education, STKIP Kusuma Negara, Jakarta, Indonesia

*natiqotul@stkipkusumanegara.ac.id

Abstract

The aim of this research is to determine the relationship between student learning independence and mathematical problem-solving ability regarding the Pythagorean theorem in the eighth grade at SMP Islam Al Asmaniyah Tangerang for the 2023-2024 academic year. This quantitative study employs a survey method with correlational analysis techniques. The population consists of all eighth-grade students at SMP Islam Al Asmaniyah, with a sample of 30 students obtained through Cluster Random Sampling. Data were analyzed using descriptive and inferential statistics. Based on the analysis results, the hypothesis test calculated using Pearson's Product Moment correlation yielded an r_{xy} value of 0.600, indicating a moderately strong correlation. Thus, it can be concluded that there is a positive relationship between student learning independence and problem-solving ability regarding the Pythagorean theorem in the eighth grade at SMP Islam Al Asmaniyah Tangerang. The author demonstrates that there is a positive correlation between student learning independence and mathematical problem-solving ability concerning the Pythagorean theorem.

Keywords: Relationship, Problem-Solving Ability, Learning Independence.

1 INTRODUCTION

Mathematics is a subject studied at every level of education. Its purpose is not only to increase knowledge to prepare for higher education but also to be useful in daily life and in other fields of knowledge. Mathematics is a discipline that has its own specificity compared to other fields of study, which must take into account the essence of mathematics and the abilities of students in learning. Mathematics is a science characterized by its discipline, which helps students become more disciplined in their studies. Given the importance of mathematics in life, students must be able to learn mathematics effectively. One way to assess students' learning abilities is through the grades they achieve in relation to the competency standards set by the school.

Recognizing the importance of mathematics in life, students must be capable of studying mathematics well. The ability of students to learn can be reflected in the grades they obtain, indicating whether they meet the competency standards established by the school. Mathematics is regarded as the queen of sciences, serving as a foundation for other fields of knowledge (Latifah et al., 2021). Many branches of knowledge develop their theories based on mathematical concepts, making it essential for every student to master and understand mathematics. By studying mathematics, students are trained to think critically and systematically to solve various problems related to mathematics as well as everyday life. Higher Order Thinking Skills include critical thinking, logical, reflective, metacognitive, and creative. One of the conceptual learning oriented towards high-level thinking skills (HOTS) is problem solving.

In mathematics, problem-solving can involve non-routine questions or word problems, which require deeper thinking for correct procedures. Therefore, problem solving can

enhance critical, logical, and systematic thinking skills. Similar ideas are presented by Muhsetyo Gatot et al., who state that the benefits of problem-solving experiences include students becoming (1) creative in thinking; (2) critical in analyzing data, facts, and information; and (3) independent in action and work.

Problem-solving is an effective approach for teaching higher-order thinking processes. Additionally, this learning helps students process existing information in their minds and construct their own knowledge about the social world and their surroundings (Bernard, 2019). A person's ability to solve mathematical problems is also influenced by another factor: self-concept. Self-concept includes beliefs, feelings, and individual evaluations about oneself, as well as its impact on social interactions with the surrounding environment (Aisyah et al., 2019). Individually, students will possess varying problem-solving skills influenced by several factors. There are six aspects that can be used to measure the extent of students' problem-solving skills: identifying problems by defining them, exploring problems by determining related objects, planning solutions where students develop plans to solve problems, implementing the plan, checking solutions, and evaluating.

Based on observations conducted at SMP Islam Al Asmaniyah Tangerang and interviews with several students, it was found that students tend to wait for help from their peers when they encounter difficulties in learning mathematics and do not review material they have not mastered. This indicates a lack of student learning independence. The issue identified at SMP Islam Al Asmaniyah Tangerang is that students' mathematical problem-solving abilities concerning the Pythagorean theorem are still relatively low, as seen from the results of the Semester 1 Assessment for students in grades VIII A, VIII B, and VIII C for the 2023/2024 academic year. Many students scored below 7. Data obtained from the mathematics teacher show that the average scores are 63 for VIII A, 55 for VIII B, and 60 for VIII C, resulting in an overall average of 59.33, while the Minimum Completeness Criteria is set at 70. These scores are still considered low.

One of the topics in the eighth-grade mathematics curriculum at SMP Islam Al Asmaniyah Tangerang is the Pythagorean theorem. In this topic, students focus on analyzing their mathematical problem-solving abilities in solving problems related to the Pythagorean theorem, such as calculating the area of triangles, the area of squares, and the squares and square roots of numbers based on higher-order thinking skills (HOTS).

Learning independence is a student's ability to independently seek learning information from sources other than the teacher (Huri Suhendri and Tuti Mardalena, 2020). In addition to cognitive aspects, affective aspects are also important in mathematics. The affective aspect plays a role in students' success in mathematics learning, and this affective aspect is learning independence or self-regulated learning (Hana Rizkia Mulianty, 2019: 1071-1072). According to Mudjimin, independent learning can be defined as an active learning process driven by the intention to master a competency to solve a problem, built upon existing knowledge or skills. Learning independence is crucial and should be a focus for all parties involved in education. With their independence in learning, students can manage and direct their feelings without external influence.

Benson outlines principles that can enhance learning independence, including: (a) actively involving students, (b) providing choices in learning and learning resources, (c) offering opportunities to choose and decide, (d) encouraging students, and (e) promoting reflection. Learning independence plays an essential role in improving students' problem-solving abilities, particularly in mathematics education. This aligns with Long's statement that views learning as a cognitive process influenced by several factors such as individual circumstances, prior knowledge, attitudes, personal perspectives, content, and presentation methods. An important sub-factor of individual circumstances affecting learning is learning independence. Individuals with learning independence tend to be less influenced by others and are more proactive in solving problems on their own without expecting help from others. With this independence, they are likely to strive to gain a deeper understanding of the material being studied.

In line with this, Sari et al. (2022) state that students with a good understanding of concepts will be able to solve various types of mathematical problems effectively. This

statement aligns with the views of several researchers who indicate that a strong conceptual understanding enhances other foundational skills, such as reasoning, communication, connection, and problem-solving.

Thus, it can be inferred that the higher the level of students' learning independence, the higher their mathematical problem-solving abilities will be. Conversely, a lower level of learning independence is likely to correlate with lower mathematical problem-solving skills. As students develop greater independence in learning, they will encounter more problems and ultimately learn how to solve these issues, thereby improving their mathematical problem-solving abilities. The aim of this research is to investigate the relationship between students' learning independence and problem-solving in mathematics for eighth-grade students in the 2023/2024 academic year at SMP Islam Al Asmaniyah Tangerang.

2 RESEARCH METHODS

This research was conducted at SMP Islam Al Asmaniyah Tangerang, located at Jl. Diklat Pemda, Legok Dukuh Pinang No. Rt.6/Rw.3, Bojong Nangka, Kecamatan Kelapa Dua, Kabupaten Tangerang. The study employed a survey method with correlational analysis techniques, aiming to find relationships or influences between two or more variables. This method was used to determine the values of each variable while providing an overview of the defined variables and investigating their relationships. The research approach used was quantitative, based on numerical or statistical considerations of a variable, allowing for separate analysis followed by connections between them.

In this study, the researcher sought to explore the relationship between learning independence and mathematical problem-solving abilities concerning the Pythagorean theorem among eighth-grade students at SMP Islam Al Asmaniyah Tangerang. The sampling technique used was cluster random sampling. The instruments established by the researcher included a questionnaire to measure learning independence and a test in the form of essay questions to assess the learning outcomes of eighth-grade students.

Data were analyzed using descriptive statistics and inferential statistics to describe the characteristics of data for each variable, including the lowest and highest scores, mean, median, mode, standard deviation, and variance, along with prerequisite tests such as normality and linearity tests. Hypothesis testing encompassed correlation coefficient tests, significance tests for the correlation coefficient (t-tests), and tests for significance.

3 RESULT AND DISCUSSION

From the questionnaire data obtained from 30 students, the scores for the learning independence variable ranged from a minimum of 71 to a maximum of 94. The average score was 79.83, the median (middle value) was 78.50, the mode (most frequent value) was 77.02, the variance was 33.21, and the standard deviation was 5.76.

From the research data collected through objective tests regarding mathematical problem-solving abilities related to the Pythagorean theorem, the scores from 30 eighth-grade students at SMP Islam Al Asmaniyah Tangerang showed a highest score of 37 and a lowest score of 28, with an average of 32.1. The median (middle value) was 32.1, the mode (most frequent value) was 32.3, the variance was 6.73, and the standard deviation was 2.59.

3.1 Sub Result

From the Liliefors test calculation, the obtained L calculated is 0.134, while the L table for $n = 30$ at a significance level of 0.05 is 0.162. Since $L_{\text{calculated}} < L_{\text{table}}$, it can be concluded that the data for variable X is distributed.

From the Liliefors test calculation, the obtained L calculated is 0.099, while the L table for $n = 30$ at a significance level of 0.05 is 0.162. Since $L_{\text{calculated}} < L_{\text{table}}$, it can be concluded that the data for variable Y is normally distributed.

Table 1. Normality Test of Variable X and Variable Y

Variable	N	α	$L_{\text{calculated}}$	L_{table}	Decision
X	30	0,05	0,134	0.162	H_0 diterima
Y	30	0,05	0,099	0.162	H_0 diterima

3.1.1 Sub Introduction 1

The simple linearity test was conducted to determine the distribution of the two data sets. This was done using ANAVA for simple linear regression.

Table 2. Anava Test

Statistics	JK	Dk	Rk	Fobs	Fa	Decision
Regression	72.6	1	72,60			
Tuna match	62,13	16	3,88	1,3	2,62	F obs < Fa
Pure Error	35,97	12	2,99			
Total	170.70	29				Linear

From the test table, the obtained F calculated is 1.30 and F table is 2.62. Since F calculated is less than F table ($F_{\text{calculated}} = 1.30 < F_{\text{table}} = 2.62$), it can be stated that the relationship between learning independence and mathematical problem-solving ability on the topic of the Pythagorean theorem is linear.

3.1.2 Sub Introduction 2

Hypothesis testing used Pearson's product moment correlation. This analysis is necessary to determine if there is a positive relationship between variable X and variable Y. The obtained value is $r_{xy} = 0.600$, with a strong correlation coefficient interpretation, indicating a positive relationship between variable X and variable Y.

The calculation for the significance of the correlation is used to determine if there is a significant effect between variable X and variable Y. The condition is $t_{\text{calculated}} > t_{\text{table}}$. From the calculations, $t_{\text{calculated}}$ is 3.969, while t_{table} with $\alpha = 0.05$ is 1.701. Therefore, $t_{\text{calculated}} > t_{\text{table}}$ ($3.969 > 1.701$). It can be concluded that there is a significant effect between variable X and variable Y.

Table 3. Table Correlation Significance Test

N	α	$T_{\text{calculated}}$	t_{table}	Decision
30	0,05	3,969	1,701	H_0 accepted

The calculation of the coefficient of determination is used to determine the extent of the influence of variable X on variable Y. From the research results, the coefficient of determination was obtained as 36%, indicating the influence of variable X on variable Y, while the remaining 64% is influenced by other factors.

3.2 Sub Discussion

The hypothesis testing calculation using Pearson's Product Moment correlation yielded an r_{xy} value of 0.600. Considering the interpretation of the correlation coefficient as fairly strong, it can be concluded that there is a positive relationship between students' learning independence and problem-solving ability on the Pythagorean theorem material in class VIII at SMP Islam Al Asmaniyah Tangerang. Thus, it can be interpreted that the higher the students' learning independence, the higher their scores on the Pythagorean theorem material.

Learning independence is an activity carried out by students without reliance on others, and according to mathematical problem-solving theory, it represents the highest and most complex level of learning compared to other types of learning. The importance of problem-solving skills in students, especially in mathematics, is highlighted in Branca's statement that problem-solving ability is a general goal of mathematics education. Problem-solving encompasses methods, procedures, and strategies, which are core processes in the mathematics curriculum. It is a fundamental skill in mathematics learning.

Various research findings indicate that students who are given more problem-solving practice achieve higher scores on problem-solving tests compared to those who receive less practice. Problem-solving is a crucial part of the mathematics curriculum because, during both the learning process and its resolution, students can gain experience applying the knowledge and skills they already possess to tackle non-routine problems.

Thus, it can be concluded from this study that there is a positive relationship between students' learning independence and mathematical problem-solving ability regarding the Pythagorean theorem material.

4 CONCLUSION

Learning independence plays a crucial role in enhancing students' problem-solving abilities, particularly in mathematics education. To improve problem-solving skills, students can be given non-routine practice problems to become accustomed to solving them. The problem-solving process includes several steps to find solutions: understanding the problem, planning the solution, executing the plan, and reviewing all the steps taken. Based on the analysis results from this study, the hypothesis testing calculation using Pearson's Product Moment correlation yielded an r_{xy} value of 0.600. Considering the interpretation of the correlation coefficient as fairly strong, it can be concluded that there is a positive relationship between students' learning independence and problem-solving ability regarding the Pythagorean theorem material in class VIII at SMP Islam Al Asmaniyah Tangerang. Therefore, the author demonstrates that there is a positive relationship between students' learning independence and mathematical problem-solving ability concerning the Pythagorean theorem material.

5 REFERENCES

- Aisyah, S., Hakim, A., & Wartu, E. (2019). The Relationship of Students' Self-Concept to Mathematical Problem-Solving Ability. *Proceedings of the National Seminar on Education STKIP Kusuma Negara*, 1-5.
- Bernard, et.al. (2019). Analysis of Mathematical Problem-Solving Ability of Junior High School Students of Grade IX on Flat Building Material. *Supremum Journal of Mathematics Education*. 2 (2), 77-83.
- Effendi, Adhar (2020). Mathematics Learning with Guided Discovery Method to Improve Representation and Mathematical Problem-Solving Ability of Junior High School Students. *Journal of Educational Research*, Vol. 13 No. 2, 9-15.

- Gatot, Muhsetyo., (2020). *Elementary School Mathematics Learning*, Jakarta: Universitas Terbuka.
- Latifah, T., & Afriansyah, E. A. (2021). Difficulties in Students' Mathematical Problem-Solving Ability in Statistics Material. *Journal of Authentic Research on Mathematics Education (JARME)*, 3(2), 134-150.
- Mulianty, Hana Rizkia et al. The Relationship Between Mathematical Understanding Ability and Learning Independence of Junior High School Students Using a Contextual Approach. *Journal of Innovative Mathematics Learning (JPMI)*. Vol. 1 No. 6 (2019), pp. 1071-1072.
- Sari, et al. (2022). CUPs Learning Model Assisted by Handout Media: Impact on Mathematical Concept Understanding Ability Reviewed from Cognitive Style. *Mosharafa: Journal of Mathematics Education*. 11(1), 95-106.
- Suhendri, Huri et al., (2020). The Effect of Problem-Solving Learning Method on Mathematics Learning Outcomes Reviewed from Learning Independence. *Formative Journal*, 3 (2), 105-114.