

**THE EFFECT OF PROBLEM SOLVING LEARNING MODELS ON IMPROVING STUDENTS' MATHEMATICAL PROBLEM-SOLVING SKILLS**

**Ma'rifatus Sholihah<sup>1\*</sup>, Arini Hidayati<sup>2</sup>**

<sup>12</sup>Program Studi Pendidikan Matematika, Universitas Nurul Jadid, Probolinggo, Indonesia

\*Correspondence Email: [marifatus1611@gmail.com](mailto:marifatus1611@gmail.com)

**ABSTRACT**

*Mathematical problem-solving ability is a crucial competency that students must develop to tackle non-routine questions and real-life problems. However, observations show that many students still struggle to devise appropriate problem-solving strategies, particularly on the topic of the Pythagorean Theorem. This study aims to investigate the effect of the problem solving learning model on improving students' mathematical problem-solving abilities. The research employed a quantitative approach with a quasi-experimental method using a nonequivalent control group design. The sample consisted of two eighth-grade classes at SMP Nurul Jadid: an experimental class taught using the problem solving model and a control class taught using a conventional method. Data were collected through essay tests (pretest and posttest) and analyzed using normality, homogeneity, and Mann-Whitney U hypothesis tests. The results showed a significant difference between the experimental and control classes, with an Asymp. Sig. (2-tailed) value of  $0.003 < 0.05$ . This indicates that the problem solving model significantly improves students' problem-solving abilities. The findings suggest that students' active engagement in understanding problems, planning strategies, and solving tasks independently plays an important role in enhancing their skills. Therefore, the problem solving learning model can be considered an effective alternative in mathematics instruction.*

*Keywords: learning model; problem solving; problem-solving ability.*

## INTRODUCTION

Education is a very important and eternal need. Generally, we know that education is a universal activity in human life; therefore, education is a very important field of study and is a right for everyone. Mathematics education is regarded as a foundational discipline that has evolved rapidly over time, both in terms of its content and its applications, which can help foster students' ability to think critically, systematically, logically, creatively, and to collaborate effectively.

Mathematics is one of the subjects that plays an important role in education. There are many reasons why students need to learn mathematics. One of them, according to Cockroft in (Mulyono, 2003) is that mathematics needs to be taught to students because it is always used in our daily lives, All subjects require appropriate mathematical skills, which are a powerful means of communication, concise and clear, can be used to present information in various ways, improve logical thinking, accuracy, and awareness, and provide satisfaction in solving challenging problems. The various reasons why schools need to teach mathematics to students can essentially be summarized as everyday problems. Mathematics is one way to train students to think logically and systematically in solving mathematical problems.

Mathematical problem-solving skills are one of the most important skills for students in facing the challenges of 21st century learning. (Krulik, Stephen, Ed.; Reys, Robert E., 1980) states that problem solving is at the heart of mathematics learning because through this activity students can develop logical, analytical, creative, and critical thinking skills. Competence is also one of the main objectives of mathematics learning in the Merdeka Curriculum, which guides students to not only memorize formulas, but also be able to use them in real-life contexts (Kemendikbudristek, 2022). Problem solving in mathematics can be defined as a learning objective in mathematics that involves the reasons why mathematics is taught, the process of applying previously acquired knowledge to new and unfamiliar situations, and basic skills, namely minimal skills in evaluation (Kusumah, 2010).

In his book (Susanto, 2016) Susanto argues that problem-solving skills are a very important form of thinking in the learning process. Problem solving involves not only simple steps but also the use of various other methods, starting with data collection, information analysis, and logical conclusion drawing.

However, various international studies such as TIMSS (Trend in International Mathematics and Science Study) 2019 show that Indonesian students' mathematical problem-solving abilities are still in the low category. The report reveals that most students are only able to solve routine problems using procedures that have been taught, but experience difficulties when faced with non-routine problems that require an understanding of concepts and problem-solving strategies.(Mullis et al., 2020) This shows the need for innovation in learning methods that can train students to think critically and creatively.

The method that is still commonly used in schools is the lecture method, in which the teacher acts as the main source of information and students receive the material passively. (Sumarmo, 2010) This approach does not provide students with sufficient opportunities to actively engage in the thinking process and find solutions independently. As an alternative, the problem-solving learning model has emerged to shift the learning paradigm from teacher-centered to student-centered, emphasizing the processes of investigation, discussion, and solution-seeking for contextual problems.

According to (Shoimin, 2014) the problem-solving learning model consists of five main syntaxes, namely: (1) problem identification, (2) organizing students to learn, (3) guiding individual or group investigations, (4) developing and presenting results, and (5) analyzing and evaluating the problem-solving process. This syntax differs from the steps outlined by (Polya, 2014) which focus solely on the stages of problem solving, because problem solving emphasizes the overall learning process from understanding the problem to evaluating the resulting solution. (Majid, 2020) states that problem solving is a way of providing understanding by stimulating students to pay attention, examine, and think about a problem in order to continue analyzing the problem as an effort to solve it.

This research was conducted at SMP Nurul Jadid, a junior high school that implements the Merdeka Curriculum but still uses conventional learning methods in most of its mathematics teaching and learning processes. Initial observations at this school indicate that students tend to experience difficulties when asked to solve contextual problems that require deeper analysis. This is the basis for the need to apply a problem-solving learning model to improve students' mathematical problem-solving skills.

A number of previous studies have examined the effectiveness of problem-solving models in mathematics learning, including: (1)(Sinaga & Anjelina Situmorang, 2021) found that there was a difference in the effect of problem-based learning models and direct learning models on students' mathematical problem-solving abilities, (2) (Doly Nasution et al., 2023) reported that the application of contextual problem-based problem solving can improve the problem-solving abilities of eighth-grade students at SMPIT Miftahul Jannah. (3) (LATIF, 2020) shows that the problem-solving model can improve student learning activities in class X of SMA Negeri 2 Sei Kanan T.P 2018/2019 in the main subject of Statistics. (4) (Maesari et al., 2020) found that the problem-solving learning model can improve the mathematical problem-solving abilities of fourth-grade students at SD Negeri 004 Bangkinang Kota. This can be seen from the test results, (5) (Muhammad et al., 2018) revealed that students who used the creative problem solving learning model showed greater improvement in mathematical problem solving skills than students who used the conventional learning model, students' attitudes toward the creative problem solving learning model were positive, and there was no correlation between students' attitudes and improvement in mathematical problem solving skills.

Based on the above description, this study aims to determine the effect of the problem-solving learning model on improving the mathematical problem-solving abilities of Nurul Jadid junior high school students and to compare the problem-solving abilities of students taught using the problem-solving learning model and the conventional model. Based on the problem formulation and theoretical framework described above, the hypothesis in this study is:

- $H_1$  (alternative hypothesis) : The problem-solving learning model has a significant effect on the mathematical problem-solving abilities of eighth-grade students at Nurul Jadid Junior High School.
- $H_0$  (Null hypothesis) : The problem-solving learning model does not have a significant effect on the mathematical problem-solving abilities of eighth-grade students at Nurul Jadid Junior High School.

## RESEARCH METHODS

This study uses a quantitative approach with a quasi-experimental design. A quantitative approach was chosen because this study focuses on measuring the effect of applying the problem-solving learning model on students' mathematical problem-solving abilities using test instruments. (Sugiono, 2013) The design used was a nonequivalent control group design. The study involved two groups, namely an experimental class that received problem-solving model treatment and a control class that received conventional learning (lectures). (Sandu Siyoto & Muhammad Ali Sodik, 2015) The sampling technique used non-probability sampling of the purposive sampling type, taking into account the equality of students' initial abilities based on pretest scores.

**Table 1. Nonequivalent control group Design**

Group	Pretest	Actions	Posttest
Experiment	$O_1$	X	$O_2$
Control	$O_3$	Y	$O_4$

Description:

$O_1$  : Pretest given to the experimental class

$O_2$  : Posttest given to the experimental class

X : Treatment given to the experimental class using the problem-solving learning model

$O_3$  : Pretest given to the control class

The object of this study was students' mathematical problem-solving abilities in relation to the Pythagorean Theorem. The subjects of this study were eighth-grade students at Nurul Jadid Junior High School, divided into two classes: one experimental class and one control class. The main material used is Student Worksheets (LKS) for each class (Wahyuni & Zulyusri, 2023). The experimental worksheets were designed according to the syntax of the problem-solving learning model, while the control worksheets followed the lecture method. The tools used include descriptive problem-solving ability test instruments, scoring guidelines, and learning tools such as teaching modules (Widoyoko, 2012).

The research was conducted at SMP Nurul Jadid, Paiton-Probolinggo, East Java, during the second semester of the 2024/2025 academic year. The research instrument has been validated by experts and tested for reliability using Cronbach's Alpha (Puspitasari & Febrinita, 2021). Data

analysis techniques include normality tests, homogeneity tests, and hypothesis testing using the Mann Whitney U Test because the data does not meet the assumption of normality as a whole.

**RESULTS AND DISCUSSION**

The mathematical problem-solving test instrument used was first tested for reliability using Cronbach's Alpha. The test results are presented in Table 2.

**Table 2. Instrument Reliability Test**

Cronbach's Alpha	N of Items
.730	3

The reliability test results showed a Cronbach's Alpha value of 0.730, which is above 0.70. Thus, the test instrument can be considered reliable and suitable for measuring students' mathematical problem-solving abilities.

Before the treatment, both groups were given a pretest to determine their initial mathematical problem-solving abilities. The average pretest results are shown in Table 3.

**Table 3. Pre-test Results on Problem-Solving Skills**

Group Type	N	Mean	Std. Deviation	Minimum	Maximum
Eksperimen	32	38.53	16.762	8	75
Kontrol	20	37.50	15.965	8	67

The results in Table 3 show that the initial abilities of students in the experimental and control classes were relatively balanced, with almost the same average (38.53 and 37.50). This indicates that both groups were in equivalent initial conditions, so that the treatment could be compared fairly.

After the treatment, which involved applying the problem-solving model in the experimental class and the conventional method in the control class, both groups were given a post-test. The results are shown in Table 4.

**Table 4. Posttest Results on Problem-Solving Skills**

Group Type	N	Mean	Std. Deviation	Minimum	Maximum
Eksperimen	32	74.78	17.048	33	100
Kontrol	20	59.25	16.924	33	92

Table 4 shows that there was a significant difference between the two groups after the treatment. The average score of the experimental class was 74.78, which was much higher than that of the control class, which was only 59.25. This shows that there was a significant improvement in the problem-solving skills of students taught using the problem-solving model.

Next, a normality test was conducted to determine whether the data was normally distributed or not. The normality test was conducted using the Kolmogorov Smirnov test, which can be seen briefly in Table 5 below.

**Table 5. Normality Test Data**

		Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Nilai Pretest	Eksperimen	.161	32	.035	.963	32	.326
	Kontrol	.161	20	.186	.954	20	.428
Nilai Posttest	Eksperimen	.185	32	.007	.918	32	.018
	Kontrol	.158	20	.200*	.952	20	.404

Table 5 shows that based on the data obtained from the normality test, the experimental and control classes indicate that the pretest data for the control and experimental classes and the posttest data for the control class are normally distributed because (sign) > 0.05. However, the posttest data for the experimental class shows an Asymp Sig. value of 0.018, which is not normally distributed because the probability (sign) < 0.05. This indicates that there was a change in the experimental class after the treatment was administered. Following the normality test, a Levene's Test for homogeneity

of variance can be conducted to determine whether the two groups are equivalent, as shown in Table 6 below.

**Table 6. Homogeneity Test Data**

		<b>Levene Statistic</b>	<b>df1</b>	<b>df2</b>	<b>Sig.</b>
Nilai	Based on Mean	.043	1	50	.837
	Based on Median	.028	1	50	.869
	Based on Median and with adjusted df	.028	1	48.242	.869
	Based on trimmed mean	.045	1	50	.834

Based on Table 6, the data obtained from the homogeneity test shows a Sig. value of 0.837. The data values for the experimental class and control class are homogeneous (equivalent) because the probability (sign) > 0.05. This indicates that there was a change after the treatment was administered. Based on the results of the normality and homogeneity tests, the hypothesis test used was the nonparametric Mann-Whitney U test because the combined posttest data were not normally distributed. This was explained in the previous section. The basis for the decision to use the nonparametric Mann-Whitney U test is as follows:

1. If the *Asymp. Sig. (2-tailed)* > 0,05, then  $H_0$  is accepted and  $H_1$  is rejected.
2. If the *Asymp. Sig. (2-tailed)* < 0,05, then  $H_0$  is rejected and  $H_1$  is accepted

**Table 7. Mann Whitney U Test Hypothesis Testing**

	<b>Student Posttest Scores</b>
Mann-Whitney U	165.000
Wilcoxon W	375.000
Z	-2.942
Asymp. Sig. (2-tailed)	.003

Based on Table 7 above, it shows that *Asymp. Siig. (2-tailed)* is 0.003, which is smaller than 0.05, meaning that  $H_0$  is rejected and  $H_1$  is accepted. Thus, the problem-solving learning model has a significant effect on the mathematical problem-solving ability of eighth-grade students at SMP Nurul Jadid.

The results of this study indicate that the application of the problem-solving model has a significant positive impact on junior high school students' mathematical problem-solving abilities. The average score of the experimental class increased more than that of the control class, from 38.53 on the pretest to 74.78 on the posttest. Meanwhile, the control class only increased from 37.50 to 59.25. This is in line with Setiawan's (2018) research, which states that problem solving improves students' critical thinking skills. Putri and Suryadi's (2019) research also found that problem-solving-based learning strategies make students more independent in identifying and formulating solution strategies.

Theoretically, these results reinforce Branca's (1980) view that problem solving is at the core of mathematics learning. The problem-solving model provides students with the opportunity to actively understand problems, plan, implement, and evaluate results. This contrasts with the lecture method, which tends to make students passive recipients of information. Additionally, the findings of this study are relevant to Vygotsky's (1978) concept of the Zone of Proximal Development, which emphasizes the importance of the teacher's role in guiding students to discover problem-solving strategies without providing direct answers. The teacher acts as a facilitator, while students are active participants in the learning process.

Thus, this study confirms that the problem-solving model can be used as an effective alternative method of teaching mathematics, especially in improving problem-solving skills in relation to the Pythagorean Theorem.

## CONCLUSIONS

Based on the results of data analysis and discussion, it can be concluded that the problem-solving learning model has a significant effect on improving students' mathematical problem-solving abilities.

Students who learn using the problem-solving model show higher improvement in results compared to students taught using conventional learning methods. This is evidenced by the significant difference in posttest scores between the experimental and control groups, with a significance level of  $0.003 < 0.05$ . The problem-solving model is effective because it actively involves students in understanding, planning, solving, and reflecting on mathematical problems. The application of this model can help students build a deeper conceptual understanding and practice critical and systematic thinking skills. Therefore, the problem-solving model can be used as a relevant and effective alternative learning strategy to improve students' mathematical problem-solving skills, especially in the Pythagorean Theorem material.

### ACKNOWLEDGEMENTS

The author would like to thank SMP Nurul Jadid for granting permission and providing full support for this research. The author would also like to express his highest appreciation to the teachers and eighth-grade students who actively participated in the research process. The author would also like to express his gratitude to his supervisor for providing guidance, advice, and valuable input in the preparation of this research. Last but not least, the author would like to thank his family and colleagues for their prayers, motivation, and encouragement.

### BIBLIOGRAPHY

- Doly Nasution, M., Ramadhan, R., Kunci, K., & Pemecahan Masalah, K. (2023). Pengaruh Model Pembelajaran Problem Solving Terhadap Kemampuan Pemecahan Masalah Siswa Kelas VIII SMPIT Miftahul Jannah. *Journal Of Social Science Research*, 3, 260–268.
- Kemendikbudristek. (2022). Panduan Pembelajaran dan Asesmen. *Badan Standar, Kurikulum, Dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, Dan Teknologi Republik Indonesia*, 123.
- Krulik, Stephen, Ed.; Reys, Robert E., E. (1980). *Problem Solving in School Mathematics*. National Council of Teachers of Mathematics 1980 Yearbook.
- Kusumah, Y. S. (2010). DAMPAK PENDIDIKAN MATEMATIKA REALISTIK MASALAH SISWA SMP. 1(1), 41–51.
- LATIF, A. (2020). Pengaruh Metode Pembelajaran Problem Solving Terhadap Aktivitas Belajar Siswa. *Jurnal Eduscience*, 7(2), 1–9. <https://doi.org/10.36987/jes.v7i2.1907>
- Maesari, C., Marta, R., & Yusnira, Y. (2020). Penerapan Model Pembelajaran Problem Solving Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematika Siswa Sekolah Dasar. *Jurnal Pendidikan Dan Konseling (JPDK)*, 2(1), 12–20. <https://doi.org/10.31004/jpdk.v1i2.531>
- Majid, A. (2020). *Perencanaan pembelajaran mengembangkan standar kompetensi guru*.
- Muhammad, G. M., Septian, A., & Sofa, M. I. (2018). PENGGUNAAN MODEL PEMBELAJARAN CREATIVE PROBLEM SOLVING UNTUK MENINGKATKAN KEMAMPUAN PEMECAHAN MASALAH Mosharafa: Jurnal Pendidikan Matematika Mosharafa: Jurnal Pendidikan Matematika. *Mosharafa: Jurnal Pendidikan Matematika Volume*, 7(3), 315–326.
- Mullis, I. V. S., Martin, M. O., Foy, P., Kelly, D. L., & Fishbein, B. (2020). *TIMSS 2019 International Results in Mathematics*.
- Mulyono, A. (2003). *Pendidikan Bagi Anak Berkesulitan Belajar*. Rineka Cipta.
- Polya, G. (2014). *How to Solve It: A New Aspect of Mathematical Method* (berilustra).
- Puspitasari, W. D., & Febrinita, F. (2021). Pengujian Validasi Isi (Content Validity) Angket Persepsi Mahasiswa terhadap Pembelajaran Daring Matakuliah Matematika Komputasi. *Journal Focus Action of Research Mathematic (Factor M)*, 4(1), 77–90. [https://doi.org/10.30762/factor\\_m.v4i1.3254](https://doi.org/10.30762/factor_m.v4i1.3254)
- Sandu Siyoto & Muhammad Ali Sodik. (2015). *Dasar Metodologi Penelitian*. February, 17.
- Shoimin, A. (2014). *68 Model pembelajaran inovatif dalam kurikulum 2013*. Ar- Ruzz media 2014. [http://opac.library.um.ac.id/index.php?p=show\\_detail&id=54550](http://opac.library.um.ac.id/index.php?p=show_detail&id=54550)
- Sinaga, R. S., & Anjelina Situmorang, S. R. (2021). Pengaruh Model Pembelajaran Berbasis Masalah Terhadap Kemampuan Pemecahan Masalah Matematika Siswa Kelas Viii Smp Abdi Negara Binjai. *Serunai: Jurnal Ilmiah Ilmu Pendidikan*, 6(2), 92–99. <https://doi.org/10.37755/sjip.v6i2.332>
- Sugiono. (2013). *Metode penelitian pendidikan pendekatan kuantitatif, kualitatif, dan R&D*. Alfabeta.
- Sumarmo, U. (2010). *Berpikir dan disposisi matematik: apa, mengapa, dan bagaimana dikembangkan pada peserta didik*. 27.

Susanto, A. (2016). *Teori Belajar dan pembelajaran di Sekolah Dasar*. Kencana.

Wahyuni, D., & Zulyusri, Z. (2023). Meta-Analisis Validitas Penggunaan LKPD Sebagai Media Pembelajaran. *Jurnal Ilmiah Profesi Pendidikan*, 8(3), 1485–1491.  
<https://doi.org/10.29303/jipp.v8i3.1496>

Widoyoko, E. putro. (2012). *tekhnik penyusunan instrumen penelitian*. Pustaka Pelajar.