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Problem Solving Ability in Problem Based Learning Based on Ethnomathematics Assisted by Teachmint

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ABSTRAK

Tujuan penelitian ini yaitu mengetahui model PBL barbasis etnomatematika berbantuan *teachmint* dalam meningkatkan kemampuan pemecahan masalah siswa pada materi bangun ruang sisi lengkung. Jumlah sampel pada penelitian ini 20 siswa kelas IX SMP Islam Salakbrojo Kabupaten Pekalongan. Penelitian ini menggunakan penelitian eksperimen desain *The Group Pretest-postest*. Subjek dalam penelitian ini adalah siswa kelas IX SMP Islam Salakbrojo Kabupaten Pekalongan. Pengumpulan data yang digunakan tes kemampuan pemecahan masalah barbasis etnomatematika. Teknik analisis data dalam penelitian ini adalah uji *paired t-test*. Hasil penelitian ini adalah hasil uji *paired sample t-test* menunjukkan nilai $t_{hitung} < t_{tabel}$ atau 5,445 < 2,09302 maka H_0 ditolak yang berarti kemampuan pemecahan masalah siswa melalui model PBL barbasis etnomatematika pada materi bangun ruang sisi lengkung, hasil uji peningkatan rata-rata (N-gain) menunjukkan bahwa siswa kelas IX SMP Islam Salakbrojo yaitu 34,95 termasuk dalam kategori sedang. Rata-rata *pretest* siswa sebesar 73,25 dan rata-rata *posttest* sebesar 84,25. Oleh karena itu, dapat ditarik kesimpulan bahwa adanya peningkatan kemampuan pemecahan masalah melalui model pembelajaran *problem-based learning* barbasis etnomatematika pada materi bangun ruang sisi lengkung di SMP Islam Salakbrojo.

Kata Kunci: *Problem Based Learning;* PBL; Etnomatematika; Kemampuan Pemecahan masalah

ABSTRACT

The purpose of this study was to determine the ethnomathematics-based PBL model assisted by teachmint in improving students' problem-solving abilities in the curved-sided solid geometry material. The number of samples in this study was 20 ninth-grade students of SMP Islam Salakbrojo, Pekalongan Regency. This study used an experimental research design The Group Pretest-postest. The subjects in this study were ninth-grade students of SMP Islam Salakbrojo, Pekalongan Regency. Data collection used ethnomathematics-based problem-solving ability tests. The data analysis technique in this study was the paired t-test. The results of this study were the results of the paired sample t-test showed a value tcount < ttable or 5.445 < 2.09302 then H0 is rejected which means that students' problem-solving ability through the PBL model based on ethnomathematics on the material of curved side solid shapes, the results of the average increase test (N-gain) show that grade IX students of SMP Islam Salakbrojo, namely 34.95, are included in the moderate category. The average pretest of students was 73.25 and the average posttest was 84.25. Therefore, it can be concluded that there is an increase in problem-solving ability through the problem based learning model based on ethnomathematics on the material of curved side solid shapes at SMP Islam Salakbrojo.

Keywords: Problem Based Learning; PBL; Ethnomathematics; Problem Solving Ability

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1. INTRODUCTION

Education is very important for the development and progress of a country (Wahyuni, 2022). The role of education is to develop human potential as a whole (Maulana et al., 2022). In addition, education is closely related to learning, which is the process of changing ignorance into knowledge about a problem (Widyawati, 2016; Astuti, 2024). Mathematics is an important subject that helps students understand basic concepts, master operations, think logically and flexibly, and build a positive attitude towards this subject (Gökçe & G ü ner, 2021). Mathematics learning in schools is an important foundation for creating a more advanced society in the future (Soebagyo, 2021). This process involves the interaction of various components that aim to develop students' thinking skills in solving problems. In addition, mathematics learning allows students to build mathematical concepts independently (Ultra Gusteti, 2022). Problem solving is the main goal in learning mathematics according to the curriculum aspects (Abdullah et al., 2019; Robbani & Sumartini, 2023).

One of the important skills that students must have in learning mathematics is problem-solving skills (Dwi & Rachmani, 2021; Marianti, 2023). The objectives of learning mathematics include understanding the material, application skills in problem solving, reasoning to recognize patterns, and communication of ideas using symbols and diagrams. In addition, students are expected to relate the material to other fields and develop a positive attitude towards mathematics (NCTM, 2022). Problem-solving skills are crucial in the development of 21st-century education (Musodiqoh & Jaelani., 2024), as well as training students to use existing information to determine actions in certain situations (Sitorus et al., 2023). This is a key aspect in learning mathematics (Pakabu et al., 2024) that must be trained by students in order to be able to face various problems (Utari et al., 2020). Problem solving supports interdisciplinary connections and helps students develop a positive mathematical identity, as well as build self-confidence and creativity (NCTM, 2022). In addition, problem solving provides students with the opportunity to discuss and take over authority in learning, which has a positive impact on their preparation for future professional challenges (NCTM, 2022). The vision of mathematics learning in Indonesia emphasizes the application of concepts in solving both routine and non-routine problems (Safithri et al., 2021; Ulfa, Roza, & Maimunah, 2022). However, many students still show low problem-solving skills (Rohadatul Aisy et al., 2024). The PISA and TIMSS surveys show that students' mathematical problem-solving skills in Indonesia are still relatively low, so there needs to be improvement in this aspect (Pitriyani & Afriansyah, 2023; Faidah, 2024).

The implementation of the Independent Curriculum involves various learning strategies used by teachers, students, teams, and educational institutions to make learning more interactive. Among these strategies, discovery learning (DL) and problem-based learning (PBL)

are recommended, with PBL proven to be more effective in improving problem-solving skills. Hanifah's (2021) research shows that the average posttest score for DL was 70.90, while for PBL it was 78.15, which means PBL is better for grade 4 students in thematic learning (Hemalya, 2024). Ethnomathematics is an approach that connects mathematics with culture and everyday life (Astria & Kusno, 2023; Wibawa et al., 2024). Ethnomathematics helps students understand mathematics in their cultural context (Julianto et al., 2021; Khalil, 2023). Ethnomathematics is important in mathematics education (Ardiansyah et al., 2023) and focuses on local wisdom to improve cultural understanding in education (Saphira, 2022).

Interviews with mathematics teachers at SMP Islam Salakbrojo, Pekalongan Regency, revealed that low problem-solving skills were caused by a lack of routine practice questions and questions that were not related to culture. This makes it difficult for students to understand mathematics. Research shows that the average score of students' initial ability tests is 60, but students still feel bored and have difficulty with more complex problems (Dewi et al., 2018). According to Purwati, students are often given questions that are not challenging, so they are not used to more difficult questions (Purwati, 2020). Student difficulties include: 1) dislike of long story questions; 2) lack of mastery of basic material; and 3) difficulty in determining a solution strategy. Mathematics learning also requires the assistance of technology to support students (Maftukhah & Waluya, 2024). Teachmint is an application that can improve students' problem-solving skills (Nainggolan & Panjaitan, 2024).

2. METHOD

This research is an experimental research with One Group Pretest-Posttest design (Ratminingsih, 2010). The research procedure consists of several steps, namely: (1) determining the focus of the research, which is related to the application of the Project Based Learning (PBL) model based on ethnomathematics to problem-solving abilities; (2) conducting a preliminary study to investigate students' abilities; (3) formulating problems based on the findings obtained; (4) compiling a theoretical framework; (5) creating a research framework; (6) developing a hypothesis; (7) choosing a research method; (8) determining relevant variables and indicators; (9) compiling research instruments; (10) collecting data; (11) analyzing data; and (12) drawing conclusions. The subjects in this study consisted of 25 students of class IX B at SMP Islam Salakbrojo, Pekalongan Regency. The application of the PBL model based on ethnomathematics was carried out in learning about the material of curved side space shapes. Data were collected through tests carried out before learning began and after learning was completed. This test aims to measure students' problem-solving abilities, consisting of five descriptive questions arranged based on indicators of problem-solving abilities. Before being used, the test was tested for validity through the application of a validity test. Before conducting

data analysis, a normality test was carried out as a preliminary requirement. The data analysis techniques adopted in this study include paired t-test and N-gain tests, based on predetermined criteria.

Table 1. N-gain category

Intervals	Category
$g \geq 0{,}70$	High
$3 \leq g < 0{,}70$	Medium
$g < 0{,}70$	Low

3. RESULT AND DISCUSSION

The Problem Based Learning (PBL) model that integrates ethnomathematics is applied to improve students' problem-solving abilities in the material of curved side space shapes. This study was conducted by implementing the PBL model based on ethnomathematics. The learning steps can be seen in Table 2.

Table 2. Problem based learning based ethnomathematics

Phase	Learning Activities
Phase 1: Problem orientation	a. Discussing learning objectives. b. Describing what will be done in learning.
Phase 2: Organizing students to conduct research	Helping students define and organize learning tasks related to ethnomathematics-based problems on teachmint.
Phase 3: Helping students conduct investigations independently and in groups	Encourage students to obtain accurate information about problems in the surrounding environment based on ethnomathematics, conduct experiments, and seek explanations and solutions.
Phase 4: developing and presenting work results	Helping students in planning and preparing their work, and support them in expressing their opinions.
Phase 5: Analyze and evaluate	Helping students reflect and evaluate their work results (Amalia, Purwaningsih, & Fasha, 2021).

Before learning, a pretest was conducted, and after that, a posttest was conducted to collect data on thinking skills. Data analysis used a paired t-test, after previously conducting a normality test with the Shapiro-Wilk formula through the SPSS 27 program to ensure normal class distribution. The results of the normality analysis are as follows (see Table 3).

Table 3. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
posttest	.182	20	.081	.942	20	.266
pretest	.246	20	.003	.916	20	.082

a. Lilliefors Significance Correction

Based on the Table 3, the analysis of the normality test with the Shapiro-Wilk formula using SPSS 27 shows that the significant value for the class before learning with the PBL model based on ethnomathematics assisted by teachmint is 0.082, which is greater than 0.05, so H0 is accepted and the data is normally distributed. The significant value for the class after learning is 0.266, also making H0 accepted, indicating that the data after learning is also normal. After meeting the prerequisite tests, the next step is to conduct a paired sample t-test. The following are the results of the data analysis and the hypothesis used.

H_0: $\mu_1 \leq \mu_2$ (problem solving ability after implementing the PBL model based on ethnomathematics assisted by teachmint is the same as the problem-solving ability before implementing the PBL model based on ethnomathematics assisted by teachmint)

H_a: $\mu_1 > \mu_2$ (problem solving ability after implementing the ethnomathematics-based PBL model assisted by teachmint is not the same as the problem-solving ability before implementing the ethnomathematics-based PBL model assisted by teachmint).

Paired sample t-test was used to compare the mean values between pretest and posttest. This process was carried out using SPSS 27, and the results can be seen in Table 4.

Tabel 4. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	postest - pretest	9.00000	5.28155	1.18099	6.52816	11.47184	7.621	19	<.001

Based on the Table 4, the results of the test of the difference in average pretest and posttest scores using the SPSS 27 program show a value of sig (1-tailed) yaitu $\frac{sig\ (2-tailed)}{2}$ or as big as < 0,0005, sehingga sig 1-tailed < 0,05. From this, it means that there is a significant difference between problem-solving ability before and after using ethnomathematics-based problem-based learning. The N-Gain test is used to determine the effect of the ethnomathematics-based problem-based learning model assisted by teachmint before and after being used to improve problem-solving ability. The results of the calculation of the average N-gain value are presented in the following Table 5.

Tabel 5. N-Gain Test Table and Pretest and Posttest Improvement

Category	Value
Pretest	74,25
Posttest	83.25
Average Difference	9
N-Gain class	34,95

Category	Value
Category	Medium

Based on the Table 5, the results of the average increase test (N-gain) show that grade IX students of SMP Islam Salakbrojo have a score of 34.95, which is included in the moderate category. Furthermore, a gain test was conducted to measure how much the problem-solving ability in depth increased. The average pretest score of students was 74.25, while the average posttest score was 83.25. From here, it can be concluded that there is an increase in problem-solving ability through the problem-based learning model with an ethnomathematics approach assisted by teachmint on the material of curved-sided solid shapes at SMP Islam Salakbrojo. This is reinforced by the research of Amalia, Purwaningsih, and Fasha (2021) in their journal entitled the application of ethnomathematics-based problem-based learning to mathematical problem solving. The study showed that the value $t_{count} < t_{table}$ or 6,375 < 2,09302, so that H0 is rejected, which means that the application of the ethnomathematics-based PBL model can improve problem-solving abilities.

Tabel 6. N-gain Category

Intervals	Category
High ($g \geq 0{,}70$)	2
Medium ($3 \leq g < 0{,}70$)	10
Low ($g < 0{,}30$)	8

From the Table 6, the results of the n-gain test, it can be seen that many students experienced an increase, with 12 people in the high and medium categories, while 8 people were in the low category. This shows that students' problem-solving abilities increased during learning. Research by Anggita et al. (2024) supports this finding, showing that the N-gain value with high criteria showed an average increase.

The results of this test are in line with learning in the field. The ethnomathematics-based PBL model is implemented through several steps, such as problem orientation, organizing students to learn, guiding students' experiences individually and in groups, presenting students' work results, and evaluating the learning process. The problems given at the orientation stage are related to the Syawalan Gunungan Megono tradition. In addition, students are also given the opportunity to find their own problems in their environment and solve them. This approach makes students more familiar with the problems given, making it easier for them to solve problems in various ways. In this way, students can directly find and solve problems in their environment, which in turn develops their problem-solving skills.

The Learning Objective Achievement Criteria (KKTP) used in data analysis is 72, which is the KKM for Mathematics subjects at SMP Islam Salakbrojo. The average class score obtained

was 83.25, with 75% of students successfully achieving completeness, which is included in the good category with a score of 90%. The interview results showed that most students did not know the Syawalan tradition in Pekalongan district. However, they were still able to understand and work on the questions well. Students felt that ethnomathematics-based test questions were more interesting because they could learn about the culture around them.

This study is in line with other studies that show a significant influence between the two learning approaches. The results of the study showed that students who applied the Problem Based Learning approach integrated with ethnomathematics had better problem-solving skills compared to students who used the conventional Problem Based Learning approach. Before the implementation, the ethnomathematics-based approach had shown a higher average score. In this context, ethnomathematics acts as a differentiator between the two approaches, providing a new dimension in mathematics learning. Ethnomathematics teaches how to view mathematics from a broader perspective through practices and methods related to culture, and relates it to the context as a whole (Lestari & Murtiyasa, 2023).

Problem-based learning models that integrate ethnomathematics have a positive impact on student learning outcomes. This approach is in line with scientific methods and connects subject matter with local culture, so that it can increase student interest and create a more active learning atmosphere. It is hoped that this approach will increase student enthusiasm in achieving optimal learning goals (Safitri et al., 2020).

Problem-based learning that integrates ethnomathematics has a significant influence on students' problem-solving abilities. This approach combines mathematical concepts with local cultural contexts, so that students are able to understand mathematics through experiences that are relevant to their daily lives. In the learning process, the teacher introduces problems taken from the cultural context, especially the Syawalan Gunungan Megono tradition in Pekalongan Regency. Students are then grouped to collaborate in solving problems by searching for information and data from available learning resources and exploring examples of ethnomathematics around them. Furthermore, they are invited to present the results of their problem solving and reflect (Qomariyah & Subekti, 2021). Through these steps, ethnomathematics-based problem-based learning can optimize the development of students' problem-solving abilities, because they learn to view mathematics as an integral part of their lives.

Based on the results of the research and discussion, the results of the paired sample t-test showed a value of t count <t table or 6.375 < 2.09302, so H0 was rejected, which means that the implementation of the ethnomathematics-based PBL model in improving students' problem-solving abilities in the material of curved side structures. The results of the average increase test (N-gain) showed that grade IX students of SMP Islam Salakbrojo, namely 34.95,

were included in the moderate category. The average pretest of students was 74.25 and the average posttest was 83.25. So it can be concluded that there is an increase in problem-solving ability through the ethnomathematics-based problem based learning model on the material of curved side space shapes at SMP Islam Salakbrojo.

4. CONCLUSION

Based on the results of the research and discussion, the results of the peered sample t-test showed a value of t count <t table or 5.445 <2.09302, so H0 was rejected, which means that the application of the PBL model with ethnomathematics nuances in improving students' problem-solving abilities in the material of curved side solid shapes. The results of the average increase test (N-gain) showed that grade IX students of SMP Islam Salakbrojo, namely 34.95, were included in the moderate category. The average pretest of students was 73.25 and the average posttest was 84.25. So, it can be concluded that there is an increase in problem-solving abilities through the ethnomathematics-nuanced problem-based learning model assisted by teachers in the material of curved side solid shapes at SMP Islam Salakbrojo.

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