



The Effectiveness of the Treffinger Model Assisted by Nearpod Media on Students' Mathematical Problem-Solving Abilities

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ABSTRACT

The purpose of this study was to explore the effect of the Treffinger learning model assisted by Nearpod media on students' ability to solve mathematical problems. This study departs from the understanding of the low mathematical problem-solving skills among Indonesian students, which is reflected in various international and national study results. The Treffinger model, which encourages creative thinking through three structured stages, is combined with the use of Nearpod, an interactive learning platform, to maximize learning effectiveness. This study uses a quantitative approach with a Pretest-Posttest experimental design in one group. The subjects of the study were 30 students of class VIIA at SMP Negeri 6 Yogyakarta. The instruments consisted of essay tests and observation sheets, which had been tested for validity and reliability. Analysis of the results showed a significant increase in the average score of problem-solving ability, from 22.33 (pretest) to 77 (posttest), and the results of the paired t-test showed $t\text{-count} = -19.249$ with a $p\text{-value} < 0.001$. These findings indicate that the Treffinger model supported by Nearpod is effective in improving students' mathematical problem-solving abilities. This study suggests the application of this strategy in the mathematics learning process to encourage more active student involvement and hone high-level thinking skills

KEYWORDS: Treffinger Model; Nearpod; mathematical problem solving

I. INTRODUCTION

The development of science and technology today has brought significant impact on various aspects of human life, including the field of education. Through education, individuals acquire knowledge, skills, and values that can be applied in their daily lives [1]. Therefore, the quality of education becomes an important indicator of a nation's progress.

One of the disciplines that contributes greatly to the development of thinking skills and decision-making is mathematics. Mathematics is not only centered on calculations and numbers, but also sharpens logical, analytical, creative, and critical thinking skills in solving problems [2]. One essential element in mathematics learning is problem-solving skills, which reflect students' understanding of mathematical concepts and their ability to apply them in real-life situations.

According to the National Council of Teachers of Mathematics [14], problem solving is one of the five major processes in mathematics learning, along with reasoning and proof, communication, connections, and representation. This aligns with the Ministry of Education and Culture Regulation No. 21 of 2016, which emphasizes that mathematics learning must encourage students to think logically, critically, creatively, and persistently in seeking solutions.

In reality, students' problem-solving skills in Indonesia are still relatively low. Based on the results of PISA (Programme for International Student Assessment), Indonesian students' mathematical literacy in 2018 and 2022 remains below the average of OECD member countries [3]. Similar findings were reported by Dewi et al. (2021) [15], revealing that most students struggle to understand and solve mathematical problems, particularly in planning and evaluating solutions.

To address these challenges, innovative teaching approaches that actively engage students in creative and independent problem-solving processes are required. One relevant approach is the Treffinger learning model, which emphasizes divergent and convergent thinking to solve problems systematically through three stages: basic tools, practice with process, and working with real problems [4]. This model not only enhances cognitive abilities but also builds positive attitudes in students when facing challenges.

Besides learning models, the use of technological media also plays an important role in improving learning effectiveness. One digital platform that can be utilized is Nearpod, an interactive learning platform offering various engaging features such as Virtual Field Trips, Time to Climb, collaborative boards, and formative assessments. These features can increase student engagement and motivation in learning [5]. Research by Widiawati (2022) [6] shows that the use of Nearpod in problem-based learning significantly improves students' mathematical problem-solving ability. Considering the separate effectiveness of both the Treffinger model and Nearpod, integrating the two has great potential to optimally enhance students' mathematical problem-solving skills. Therefore, this study aims to obtain empirical evidence regarding the effect of the Treffinger model assisted by Nearpod media on students' mathematical problem-solving abilities, as a strategic effort to improve the quality of mathematics learning in the digital era.

II. METHOD

This study is a quantitative research employing an experimental approach aimed at assessing the effectiveness of the Treffinger learning model assisted by Nearpod media on students' mathematical problem-solving abilities. The quantitative approach was used because it allows the researcher to measure changes in variables objectively through numerical analysis [7][8]. The design used in this study is a One-Group Pretest–Posttest Design, in which only one group of subjects receives the treatment, and the scores before and after the treatment are compared. This design was chosen because it provides an opportunity to evaluate the direct impact of the learning intervention on the variables being studied.

This study was conducted at SMP Negeri 6 Yogyakarta during the first semester of the 2024/2025 academic year. The sample was selected purposively through judgmental sampling, meaning that the sample was chosen based on specific considerations by the researcher and the supervising teacher. Based on these considerations, class VIIA was selected as the experimental class.

The independent variable was the Treffinger model with Nearpod assistance, while the dependent variable was students' mathematical problem-solving ability. Teacher, material, learning duration, and classroom conditions served as control variables. The Treffinger model consisted of three

stages—Basic Tools, Practice with Process, and Working with Real Problems—aimed at developing creative and structured problem-solving skills across four aspects: understanding the problem, planning, execution, and evaluation.

The research procedure included: (1) developing and validating instruments; (2) administering a pretest, implementing the Treffinger–Nearpod learning, and conducting a posttest; (3) processing and analyzing data.

Data were collected through tests and observations using two instruments: a mathematical problem-solving test and a learning-activity observation sheet. Test items were validated by experts using Aiken's Index and reliability was examined with Cronbach's Alpha. Data analysis involved descriptive statistics (mean, median, standard deviation) and inferential analysis using the Shapiro–Wilk normality test and a one-sample t-test processed with R Studio.

III. RESULTS AND DISCUSSION

Data Description

The results of the study reveal that the application of the Treffinger learning model supported by Nearpod had a significant impact on the mathematical problem-solving abilities of seventh-grade students at SMP Negeri 6 Yogyakarta. Details regarding students' mathematical problem-solving abilities are presented in Table I below.

Table I Description of Students' Mathematical Problem-Solving Ability

<i>Description</i>	<i>Experimental Class</i>	
	<i>Pretest</i>	<i>Posttest</i>
Average Score	6,7	23,1
Average Percentage	22,33	77
Standard Deviation	2,18	4,84

Based on the descriptive analysis in Table I above, it can be seen that the experimental class experienced an improvement. The average initial mathematical problem-solving ability of students in the experimental class was 6.7. In the pretest, none of the students met the school's minimum learning mastery criterion of 75. After receiving the treatment, the average score increased by 54.67 points.

Data Analysis

The first step in the data analysis process before conducting hypothesis testing is to ensure that the data are normally distributed. This is important because the validity of hypothesis testing depends on the assumption that the sample originates from a normally distributed population. In this study, the normality check was conducted using the Shapiro–Wilk test with a significance level of 0.05. The results are shown in Table II.

Table II. Results of Normality Test

Class	W	p-value	Decision
Pretest Mathematical Problem-Solving Ability	0.948	0.146	Normal
Posttest Mathematical Problem-Solving Ability	0.935	0.065	Normal

According to Table II, the Shapiro–Wilk normality test showed a W value of 0.948 for pretest data with a p-value of 0.146. Since the test statistic is close to 1 and the p-value is greater than α ($0.146 > 0.05$), H_0 is accepted. Likewise, the posttest normality test showed a W value of 0.935 and a p-value of 0.065, which is also greater than α ($0.065 > 0.05$), so H_0 is accepted. Therefore, it can be concluded that both the pretest and posttest data are normally distributed.

After the normality assumption was met, hypothesis testing was carried out using a paired sample t-test with the assistance of JASP software. The results are presented in Table III.

Table III. Hypothesis Testing Results

Test	t	df	p
One Sample T-test (Posttest)	-19.249	29	< .001

The table shows that the calculated t-value is -19.249 with a p-value < 0.001. Based on the decision criteria, if the t-value lies outside the range of -t-table ($t_{\text{calculated}} < -t_{\text{table}}$), then H_0 is rejected, and if the p-value < $\alpha = 0.05$, H_0 is also rejected. Since $-19.249 < -1.699$ and $p < 0.001$, H_0 is rejected. This indicates a significant difference between the pretest and posttest mean scores. Therefore, it can be concluded that the Treffinger learning model assisted by Nearpod influences students' mathematical problem-solving abilities

The aim was to reveal the effect of the Treffinger learning model assisted by Nearpod on students' mathematical problem-solving abilities. The method used was a one-group pretest–posttest design. The results show a significant increase in students' problem-solving skills after the learning session, supported by the paired sample t-test result ($t_{\text{calculated}} = -19.249 < t_{\text{table}} = -1.699$). The average posttest score (77) was higher than the pretest score (22.33) and exceeded the school's minimum mastery criterion of 75.

This improvement is presumed to result from the learning innovation employing the Treffinger model combined with Nearpod. Before the intervention, most students had not mastered the indicators of problem-solving ability. After receiving the treatment and completing the posttest, almost all students in the class were able to answer

correctly. This is reflected in the significant increase in posttest scores.

Figure 1. Student A's Answer

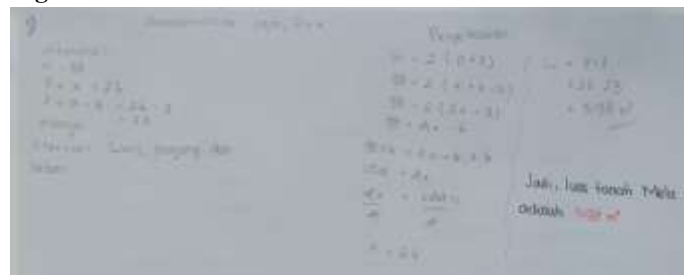


Figure 2. Student B's Answer

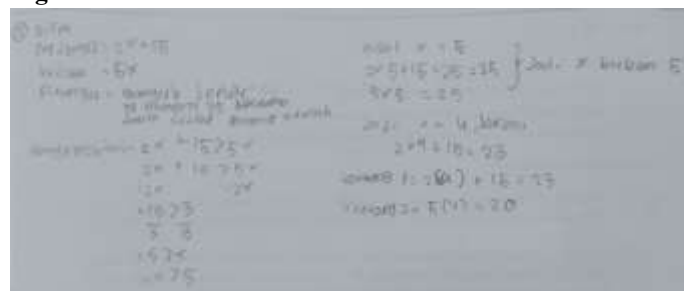
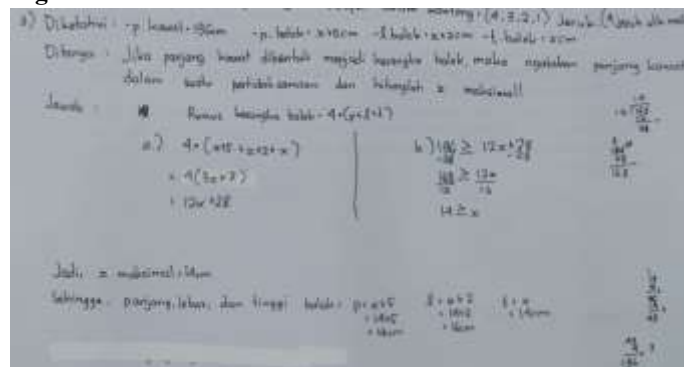


Figure 3. Student C's Answer



From Student A's answer, it is evident that the student was able to solve the problem systematically. The student demonstrated clear understanding and accurate recording of problem information, and showed good performance in planning solutions, executing plans, and evaluating results.

Student B's answer shows that they understood the problem well and solved it correctly. All four aspects of mathematical problem solving—understanding the problem, planning a solution, carrying out the plan, and checking the solution—were performed effectively. The student was also able to create a mathematical model based on the given information, which facilitated the solution process.

In Student C's response, it is generally clear that they solved problem number 3 well. The key aspects of mathematical problem solving—understanding, planning, executing, and evaluating—were adequately addressed.

The implementation of the Treffinger learning model contributed significantly to enhancing problem-

solving abilities in the experimental class. All students were actively involved in the learning process. The Treffinger method begins with student engagement and encourages curiosity and creative thinking in solving problems using their understanding of mathematical concepts [9] [10] [11].

Students solved real-life related math problems by understanding the concepts, formulating problems, exploring alternative solutions, and proposing answers or hypotheses creatively. This study confirms that the Treffinger learning model is effective in training students' mathematical problem-solving abilities [9], [12], [13].

These findings are also supported by Conny Semiawan's theory, which states that the Treffinger model begins with student activity and fosters creativity in solving mathematical problems. The analysis supports the research hypothesis that there is an effect on students' problem-solving abilities before and after using the Treffinger model assisted by Nearpod.

IV. CONCLUSION

The results of this study confirm that the use of the Treffinger learning model assisted by Nearpod effectively enhances students' mathematical problem-solving abilities. This improvement is not merely due to the innovative intervention itself, but because the intervention simultaneously facilitates both cognitive and affective engagement throughout the learning process. This conclusion is reinforced by the active participation of students during the lessons and the significant increase in posttest scores, which exceeded both the initial scores and the minimum mastery criteria.

In terms of implementation, the Treffinger model assisted by Nearpod is highly recommended for broader use in mathematics instruction, particularly for topics that require higher-order thinking skills. For future research, it is suggested that this approach be tested within a quasi-experimental framework involving control groups, as well as applied at different educational levels, to broaden the generalizability of the findings. Furthermore, exploring affective aspects such as students' learning motivation and mathematical disposition may provide a more comprehensive understanding of the long-term impact of integrating instructional models with digital technology.

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