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The Effectiveness of the Treffinger Learning Model on Students' Mathematical Problem-Solving Ability

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ARTICLE INFO	ABSTRACT
Published Online: 21 November 2025 **Corresponding Author:** Lowryk Ochdrico Lahunduitan	The purpose of this study is to examine the impact of Treffinger learning model model on students mathematical problem-solving abilities. The study took place during the 2024/2025 academic year with seventh-grade students at SMP Negeri 6 Yogyakarta, focused on the topic of Linear Equations in One Variable (LEOV), and included 33 students as research subjects. The strategy was pre-experimental design, specifically the one-group pretest–posttest design. The sample consisted of one class used the treffinger model. Data were acquired using a mathematical problem-solving test. Data analysis included both descriptive and inferential statistics, such as paired sample t-tests. The findings indicated that instructional styles considerably increased students' problem-solving abilities. These findings emphasize the necessity of using appropriate learning models to improve mathematical problem-solving skills at the junior high school level.

KEYWORDS: treffinger, mathematical problem-solving

INTRODUCTION

One of the most important ways to instill values that serve as rules in daily life is through education. Furthermore, education functions as a benchmark to evaluate the quality of past, present, and future generations. Therefore, the level of advancement or backwardness of a nation is often associated with the quality of its educational implementation [1]. Education plays a central role in advancing a nation. In line [2] statement, education is capable of optimally developing human potential, allowing every individual to contribute to building a more meaningful life.

Mathematics is an essential discipline because of its wide application in everyday life [3]. Mathematics has a great influence on the development of science and technology because it is a fundamental discipline [4]. In [5] stated that when human experiences are cognitively processed through analytical thinking, mathematical concepts are produced that can be logically and methodically processed and applied in various contexts. This supports the statement of [3] that mathematics is one of the main subjects taught in elementary and secondary schools. The ability to communicate mathematical concepts using various representations, including symbols, numbers, graphs, and tables, is one of the objectives of learning mathematics.

Because mathematics serves as the standard of scientific thinking that drives the growth of knowledge for the benefit of humankind, it is expected to help students strengthen their thinking abilities [6]. However, since elementary school students are still in the stage of concrete thinking and have not yet reached abstract understanding, mathematics learning is still considered challenging. Numbers, geometry, measurement, and data processing are some of the topics covered in mathematics classes [7].

According to [8], since mathematics is abstract and complex, learning it may become a challenge. Therefore, many students experience stress while studying mathematics, which lowers their motivation to learn. Although it is one of the basic skills that students must possess, one of the biggest problems today is the low ability of students to solve mathematical problems. In learning mathematics, students are not only required to understand the material being taught but are also expected to possess mathematical abilities that are useful in facing global challenges. Based on the types of mathematical abilities, they can be classified into five main competencies [9], namely: (1) mathematical understanding, (2) mathematical problem-solving, (3) mathematical communication, (4) mathematical connection, and (5) mathematical reasoning.

Problem-solving is an essential part of mathematics learning. It helps build students' confidence in solving mathematical problems. Furthermore, students with mathematical problem-solving skills can improve their decision-making abilities in daily life. This aligns with Cooney's opinion in [10], who stated that "possessing problem-solving skills helps students think analytically in making decisions in daily life and enhances their critical thinking abilities in facing new situations."

Students who have mathematical problem-solving abilities can solve problems through appropriate mathematical steps and principles. According to Polya in [11], the problem-solving steps include: (a) understanding the problem, (b) devising a plan, (c) carrying out the plan, and (d) looking back at the result. Thus, with mathematical problem-solving skills, students can approach problem-solving in a more structured and logically mathematical manner.

A learning approach that can inspire students to be more independent, creative, and proactive in facing and solving problems related to mathematical problem-solving skills is needed. One learning technique considered effective in fostering this ability is the Treffinger learning model. By engaging students in two different thinking processes—divergent thinking, which involves considering multiple possible solutions, and convergent thinking, which involves identifying the best answer—this model represents a creative learning approach emphasizing creative problem-solving [12].

Selecting the appropriate learning model is crucial in helping students understand and solve mathematical problems. The Linear Equation in One Variable (LEOV) is an important algebraic concept that students must understand. Nasriadi [13] explains that this content is very important in daily life, such as managing time to complete tasks or calculating expenses. Since LEOV is also the first step in learning algebra, understanding this concept is essential before progressing to more advanced algebraic content. Considering the crucial role of LEOV in facilitating initial algebraic understanding and fostering interest in learning mathematics, teachers must ensure that students have a solid understanding of this concept before moving on to higher levels of algebra [14].

From the above discussion, it is clear that the implementation the Treffinger model has the potential to enhance students' mathematical problem-solving abilities. Thus, experts believe that in order to collect empirical data on how the Treffinger model affects students' mathematical problem-solving skills, research must be conducted.

METHOD

This study aligns with the definition of a pre-experimental design, specifically the one-group pretest–posttest design, because it involves only one class and the researcher does not have full control over the variables. The research was conducted at SMP Negeri 6 Yogyakarta from October 16 to October 31, 2024, involving students of class VIIA as the research subjects for the topic of Linear Equations in One Variable (LEOV).

Before the implementation of the Treffinger learning model, a pretest was administered to measure students' initial mathematical problem-solving abilities. After the treatment, a posttest was conducted to assess any improvement in their performance following the learning intervention.

According to [15], the one-group pretest–posttest design provides an opportunity to observe changes in the dependent variable before and after the treatment, even though it lacks a control group for comparison. In this study, the independent variable (X) was the use of the Treffinger learning model, while the dependent variable (Y) was the students' mathematical problem-solving ability.

After completing the treatment, both descriptive and inferential statistical analyses were employed to interpret the data obtained from the students' mathematical problem-solving tests.

RESULTS & DISCUSSION

The study aimed to examine how the Treffinger learning model affects students' ability to solve mathematical problems involving linear equations in one variable. The research was carried out using a pre-experimental design with a one-group pretest–posttest structure. The participants consisted of students from class VIIA, who took part in five learning sessions to complete the study.

The implementation of the research began with the collection of pretest data to measure students' initial problem-solving abilities. The learning activities on linear equations in one variable were conducted from the second to the fourth meetings, followed by the posttest in the final session to assess the improvement in students' mathematical problem-solving skills after the treatment. The primary data sources of this study were the pretest and posttest instruments.

Based on the observation sheet on the implementation of the learning process, 97.68% of students actively engaged in the Treffinger learning model. The JASP application was used to analyze the pretest and posttest data obtained from the participants. Table 1 presents the initial descriptive analysis results. Furthermore, a normality test was conducted using the Shapiro–Wilk test for both pretest and posttest data. A p-value greater than 0.05 indicates that the data are normally distributed, satisfying the assumption required for subsequent statistical analysis. Table 2 summarizes the results of the normality test.

Table 1. Descriptive Analysis Results

	N	*Min*	*Max*	*Mean*	*Std.Deviation*
Pretest	33	6.67	30	19.09	5.967
Posttest	33	80	100	91.81	5.227

Table 2. Results of The Normality Test

.	*p-value*	*Desc*
Pretest	0.288	Normal
Postest	0.113	Normal

After confirming that the data met the assumption of normality, the next step was to conduct an inferential analysis to determine whether there was a significant difference between students' pretest and posttest scores after the implementation of the treffinger learning model. The hypothesis testing was carried out using the paired sample t-test, as the data were derived from the same group measured twice—before and after the treatment.

The test was conducted using the JASP application at a significance level (α) of 0.05. If the obtained p-value was less than 0.05, H_0 would be rejected, indicating that the treffinger learning model had a significant effect on students' mathematical problem-solving ability. Conversely, if the p-value was greater than 0.05, H_0 would be accepted, suggesting no significant difference between pretest and posttest results. The results of the paired sample t-test show on the table 3.

Table 3. Paired Sample t-test Result

Variable	*Df*	*Sig.*
Pretest-Postest Problem-Solving	32	<.001

The mean scores of the students' pretest and posttest differed significantly, according to the statistical analysis results using the paired sample t-test. These findings indicate that the use of the Treffinger learning model is an effective approach to help students improve their mathematical problem-solving abilities when learning the topic of Linear Equations in One Variable (LEOV). Table 4 below presents specific information on how students' problem-solving skills improved for each indicator.

Table 4. Students' Problem-Solving Skills Improved for Each Indicator

Indicator of Problem-Solving Mathematical		*Student's Results*		*Maximum Ideal*
		Pretest	*Postest*	
IPSM-1	Mean	7.70	23.74	25 (100%)
	(%)	23.11	94.95	
IPSM-2	Mean	8.84	24.58	25 (100%)
	(%)	26.52	98.32	
IPSM-3	Mean	7.20	21.72	25 (100%)
	(%)	21.59	86.67	
IPSM-4	Mean	0.13	21.59	25 (100%)
	(%)	0.38	86.36	
Jumlah		23.87	91.63	100

When examined across all indicators of students' problem-solving ability, the experimental class showed improvement, with the most significant increase observed in the fourth indicator—checking back the results—which reached an improvement percentage of 85.98%. This indicates that students became more careful and consistent in reviewing their solutions and ensuring the accuracy of their problem-solving processes. Overall, the improvement across all indicators shows that students' mathematical problem-solving skills developed comprehensively, covering the stages of understanding the problem, devising a plan, carrying out the plan, and checking the results.

The three stages of the Treffinger learning model played a significant role in supporting this improvement. In the Basic Tools stage, students were given the opportunity to identify and explore problems through student worksheets designed to help them recognize differences among variables, constants, and coefficients, as well as explanations related to linear equations. This stage strengthened students' conceptual understanding and prepared them to identify relationships among mathematical elements involved in problem-solving.

Next, in the Practice with Process stage, students practiced finding solutions to the problems they had identified. They applied appropriate strategies and performed arithmetic operations in one-variable linear equations while understanding the concept of determining the value of a variable. This stage trained students to reason systematically and to use efficient procedures in solving mathematical problems.

Finally, in the Working with Real Problems stage, students applied their understanding to solve contextual, real-life problems related to one-variable linear equations. This stage provided opportunities for students to apply the concepts and strategies they had learned to new situations, reinforcing their problem-solving competence. As a result, the Treffinger learning model enhanced students' ability to identify problems, plan and execute appropriate strategies, and verify their solutions effectively, leading to a substantial improvement in mathematical problem-solving performance.

CONCLUSION

Based on the findings and analysis, it can be concluded that the application of the Treffinger learning model has a significant positive impact on students' mathematical problem-solving abilities. The learning process structured through the three stages of the Treffinger model—Basic Tools, Practice with Process, and Working with Real Problems—effectively guides students to understand problems, plan appropriate strategies, carry out problem-solving procedures accurately, and review their results systematically.

The study revealed that each indicator of problem-solving ability experienced improvement, with the most substantial increase observed in the "checking back" indicator, indicating that students became more precise and reflective in evaluating their solutions. Therefore, the Treffinger learning model can be considered an effective approach in mathematics learning, particularly in topics such as one-variable linear equations. It provides a systematic framework that encourages active student participation, conceptual understanding, and strategic problem-solving, ultimately improving students' overall mathematical performance and independence in learning.

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