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The Effect of Implementing the Problem Posing Learning Model on the Self-Efficacy Ability of High School Students

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ABSTRACT

This study aims to analyze the effect of implementing the Problem Posing learning model on students' self-efficacy. A quasi-experimental method with a nonequivalent post-test only control group design was used. The research subjects were 11th-grade science students at Muhammadiyah Mlati Senior High School, selected using purposive sampling. Data were collected through tests, questionnaires, and observations. The instruments consisted of post-test questions to assess self-efficacy and observation sheets to evaluate teacher activities. Data analysis used a two-way ANOVA technique. The results showed a significance value of 0.000, which is less than the 0.05 significance level. This indicates that the regression coefficient is statistically significant, and the H_0 was rejected. These findings suggest that the Problem Posing learning model significantly affects students' self-efficacy. The model contributes to 85.6% of the observed increase in students' self-efficacy. Therefore, it can be concluded that the implementation of the Problem Posing learning model plays an important role in enhancing students' confidence in their academic abilities, making it a potentially effective instructional strategy in science education.

Keywords
Mathematics
Problem Posing Model
Self-Efficacy
Senior High School

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Introduction

Mathematics is a fundamental science that plays a crucial role in mastering knowledge and technology [1]. Its effectiveness has been proven through applications across various areas of life, including daily activities. Therefore, proficiency and understanding of mathematics serve as a vital foundation for individuals to navigate the challenges of modern life. In this increasingly advanced era, mathematics functions not only as an academic discipline but also as a tool to comprehend, analyze, and solve real-world problems. This makes mathematics a highly relevant and practical field of study. Its wide-ranging applications also support effective decision-making in diverse life contexts [2].

In addition, mathematics serves as an effective tool for solving practical problems. As a method of thinking and reasoning, mathematics utilizes symbols that are universal and can be understood across cultures [3]. Consequently, mathematics plays a significant role in various scientific disciplines aimed at enhancing human cognitive abilities [4]. These abilities include logical reasoning, systematic thinking, and critical thinking in problem-solving. Thus, mathematics is not only focused on outcomes but also emphasizes deep thinking processes. Its importance makes it a key component in long-term educational development.

Problem posing is an essential aspect of mathematics education [5]. This activity provides students with opportunities to utilize their knowledge and skills in solving non-routine problems [6]. The process involves understanding the problem, formulating strategies, implementing those strategies, and evaluating the results. The ability to pose mathematical problems must be continuously developed within the educational environment. Through problem posing, students become not only problem solvers but also problem creators. This contributes significantly to enhancing creativity and student engagement in the learning process.

However, field observations reveal that students' mathematical problem-solving abilities in Sleman Regency remain unsatisfactory. According to Suherman and Vidákovich [7], as well as Siswanto and Hanama [8], these abilities require continuous practice, especially for junior high school students who are transitioning from concrete to formal thinking stages. Many students also encounter difficulties in comprehending contextual problems, particularly when the problems differ from examples previously given by teachers [9]. This indicates a need for learning approaches that encourage students' active participation in understanding the context of problems. Appropriate instructional strategies can help students construct more meaningful understanding of mathematical concepts. Therefore, improving teaching methods is an urgent necessity.

One recommended approach to address this issue is the problem-posing learning model. This model encourages students to formulate their own problems based on given information,

thereby training them to analyze and solve mathematical problems more effectively [10]. In practice, students are not only trained to create problems but also to solve them [11]. This model fosters an active and meaningful learning experience while also building students' self-confidence in learning mathematics. Affective aspects, such as self-efficacy, also play an important role in the learning process. Students with high self-efficacy tend to be more confident in solving problems and more persistent when facing challenges [12].

Literature Review

A. Problem Posing Model

The problem-posing learning model is a model that engages students in the activity of formulating questions or problems based on given information and then seeking solutions to those problems. According to Leavy and Hourigan [13], problem posing directs students not only to answer questions but also to develop critical thinking skills by creating relevant problems. Through this process, students are trained to analyze information, identify relationships between elements, and generate questions that require problem-solving. This model aims to build students' logical, creative, and independent thinking abilities in addressing various problems [14].

Research indicates that the problem-posing model can enhance students' mathematical skills, including problem-solving abilities and self-efficacy. As Toheri et al. [15] states, this model is effective because students do not merely memorize concepts but also learn how to apply them in various contexts. This learning method positions students as active participants directly involved in the learning process, thereby fostering engagement, deeper understanding, and mastery of the material. Studies by Sasmita and Harjono [16] and Siswanto et al. [17] have shown positive results, demonstrating that students taught using this model exhibit better mathematical thinking skills compared to those taught through conventional methods.

Moreover, problem posing contributes to the development of affective aspects, such as learning motivation and self-confidence. When students successfully create questions and find their solutions, they gain confidence in their abilities, which further boosts their self-efficacy. Kontorovich [10] adds that the confidence developed through this model encourages students to be more persistent in overcoming learning challenges. Thus, problem posing benefits students not only in cognitive domains but also in psychological aspects, enhancing both their academic performance and personal growth.

B. Self-Efficacy Ability

Self-efficacy refers to an individual's belief in their ability to complete tasks or achieve specific goals. According to Prajono et al. [18], self-efficacy is a critical aspect of learning as it influences how individuals plan, act, and sustain effort when facing challenges. In the educational context, students' self-efficacy encompasses their confidence in academic abilities, such as

completing assignments, understanding lesson materials, and solving complex problems [19], [20]. The higher a student's self-efficacy, the greater their motivation and persistence in learning.

Several factors influence self-efficacy, including mastery experiences, vicarious experiences, social persuasion, and physiological states. Mastery experiences, such as previous successes in completing tasks, provide the most significant contribution to increasing self-efficacy [21]. Additionally, observing others' successes (vicarious experiences) and receiving verbal encouragement from teachers or peers (social persuasion) can also boost students' confidence. Conversely, repeated failures without adequate guidance can lower students' self-efficacy, leading to feelings of hopelessness or a lack of motivation to try again.

In learning, strong self-efficacy enables students to approach academic challenges with greater confidence. Fryer and Leenknecht [22] highlights that students with high self-efficacy tend to be more proactive in managing their learning, such as by organizing their time, setting goals, and evaluating their progress. On the other hand, students with low self-efficacy are more likely to give up when faced with difficulties. Therefore, teachers play a crucial role in fostering a supportive learning environment, providing opportunities for success, and encouraging students to believe in their abilities [17], [18]. These efforts are essential to helping students reach their academic potential and improving the overall quality of learning.

Materials and Methods

This study employs a quantitative approach with a quasi-experimental method, which includes a control group but cannot fully control external variables that may influence the experiment's implementation, such as students' health, nutritional intake, and learning interest [25]. The research design used is the nonequivalent post-test only control group design [26], conducted at Muhammadiyah Mlati Senior High School during the first semester of the 2024/2025 academic year. The population consists of all 11th-grade science students, with two classes selected through purposive sampling: Class 11th-grade science students 1 as the control group and Class 11th-grade science students 2 as the experimental group. The independent variable in this study is the problem posing learning model, while the dependent variable is the students' self-efficacy. The research instruments include a test to measure self-efficacy and an observation sheet to evaluate teacher activities. Data analysis was carried out using two-way ANOVA to test the research hypotheses.

Results

A. Self-Efficacy Data

Based on the results of calculations that have been carried out, student self-efficacy is grouped into three categories, namely high, medium and low, with the following details.

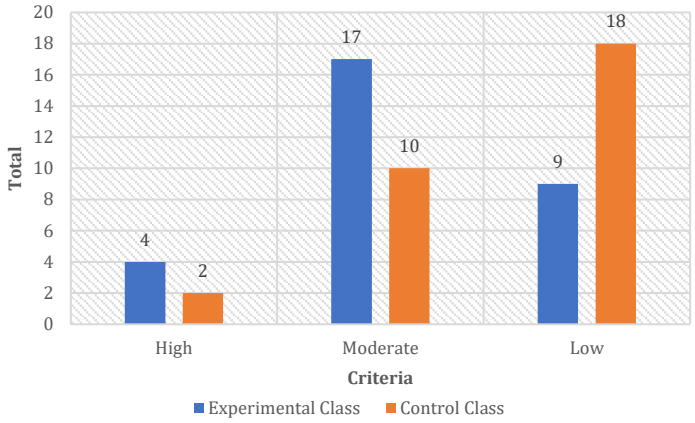


Fig. 1. Criteria for Grouping Students at Self-Efficacy Level

From Fig. 1, the results of grouping the self-efficacy of experimental class students show that there are 4 students with high self-efficacy, 17 students with moderate self-efficacy, and 9 students with low self-efficacy. The control class students showed that there were 2 students with high self-efficacy, 17 students with moderate self-efficacy, and 18 students with low self-efficacy. Before applying the problem posing learning model to the experimental class, the researcher first carried out an initial test on the classes sampled in this research. This test aims to ensure that the samples used have similar mathematical problem posing abilities. The statistical description of the initial test data was calculated using SPSS-25 and can be seen in Table 1.

Table 1. Comparison of Average Initial Data for Experimental and Control Classes

Descriptive Statistics							
Class	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Experimental	30	56.00	22.00	78.00	48.4000	18.71308	350.179
Control	30	56.00	20.00	76.00	41.1333	16.12608	260.051

In the descriptive statistics table, there is data from two groups, namely the experimental group and the control group, each with 30 participants. For the experimental group, the range value (the difference between the maximum and minimum values) is 56, with a minimum value of 22 and a maximum value of 78, an average value (mean) of 48.40, a standard deviation of 18.71, and a variance of 350.17. Meanwhile, in the control group, the range value was also 56, with a minimum value of 20 and a maximum value of 76, an average value of 41.13, a standard deviation of 16.12, and a variance of 260.05. All data in these two groups is valid, with the number of participants used being 30 people.

B. Data Analysis

After it was discovered that descriptively there was no difference in the average scores between the two classes, further analysis was carried out to confirm the difference in inferential statistics. In this research, testing was carried out using the SPSS-25 program using the

Normality test (Shapiro-Wilk). The purpose of this test is to determine whether the processed data has a normal distribution or not.

Table 2. Initial Data Normality Test Results

Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experimental	.101	30	.200*	.940	30	.089
Control	.155	30	.064	.948	30	.154

From Table 2, the Shapiro-Wilk test, which shows a significance value of 0.089 > 0.05, indicates that the data in the experimental group is normally distributed. For the control group, the significance value is 0.154 > 0.05, indicating that the data in the control group is also normally distributed. So it can be concluded that both initial data for the experimental and control classes are normally distributed. Next, a homogeneity test was carried out with the following results.

Table 3. Homogeneity Test Results

Value	Levene Statistic	df1	df2	Sig.
Based on Mean	.853	1	58	.360
Based on Median	.517	1	58	.475
Based on Median and with adjusted df	.517	1	56.109	.475
Based on trimmed mean	.830	1	58	.366

In the homogeneity test of variance, Levene's test results indicated no significant difference in variance between the experimental and control groups. The Levene Statistic value was 0.853, with a significance of 0.360 > 0.05, confirming the homogeneity of variance. Based on the initial normality and homogeneity tests, the data were found to follow a normal distribution and exhibit homogeneity, making them suitable for use in this study to measure the impact of the problem posing model on the self-efficacy of 11th-grade science students Muhammadiyah Mlati Senior High School. As part of the study, observation sheets were provided to assess classroom activities using the syntax of the problem posing model [27], as described below.

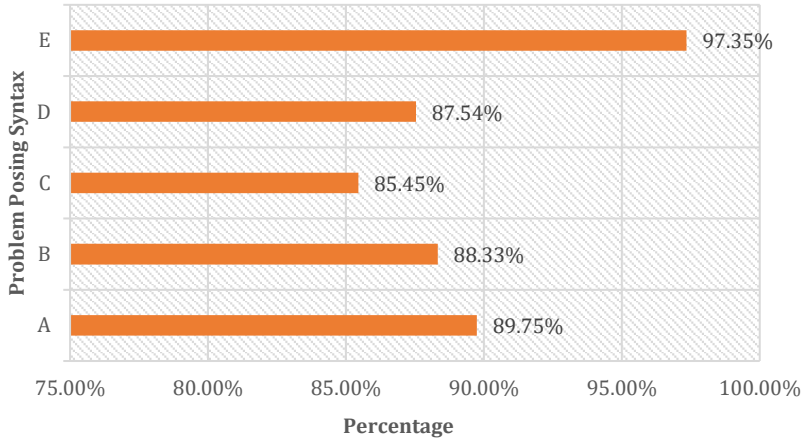


Fig. 2. Observation Results of Teacher Activities

Fig. 2 shows that the teacher explains the learning material to students with a percentage of 89.75%. Furthermore, the teacher provided sufficient practice questions with a percentage of 88.33%. The teacher also asks one or two questions and hopes that the students concerned will be able to solve them, with a percentage of 85.45%. Apart from that, the teacher asked students randomly to present their findings in front of the class with a percentage of 87.54%. Lastly, the teacher gave individual homework assignments with the highest percentage, namely 97.35%. After completing the research, the researcher then gave a final test to both classes (experimental and control) to measure students' self-efficacy abilities. After carrying out the final test, next, an inferential hypothesis test was carried out using a two-way ANOVA test. Before conducting a hypothesis test, a normality test is first carried out using the Chi Square formula and homogeneity using the F Test formula on the final data.

Table 4. Normality Test Results of the Final Data

Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experimental	.103	30	.200*	.955	30	.227
Control	.156	30	.061	.946	30	.134

From Table 4, the results of the Shapiro-Wilk test indicate a significance value of 0.227 for the experimental group, which is greater than 0.05. This indicates that the data in the experimental group are normally distributed. Meanwhile, the control group shows a significance value of 0.134, which also exceeds 0.05, indicating that the data in the control group are normally distributed as well. Therefore, it can be concluded that the final data from both the experimental and control groups are normally distributed. Subsequently, an ANOVA test was conducted to determine whether the sample data were drawn from populations with similar levels of variability. The test results are presented in Table 5.

Table 5. ANOVA[a] Test Results

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6458.177	1	6458.177	166.926	.000[b]
	Residual	1083.289	28	38.689		
	Total	7541.467	29			

Table 5 shows the significance value of 0.000. If we decide with a significance level of 5%, with a significance value of 0.000 <0.05, it shows that the significance value is lower than 0.05. This implies that the variances of the two groups of data are homogeneous. Next, test whether there is an influence of giving pocket money on the desire to learn mathematics.

Table 6 shows the further information. It explains the Sig value. equal to 0.000 < 0.05. Therefore, rejection indicates a positive and significant relationship between the Problem Posing model and Self-Efficacy abilities.

Table 6. Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.536	3.196		.794	.434
	Problem Posing	.797	.062	.925	12.920	.000

The magnitude of the influence of pocket money related to the desire to study mathematics can be seen in Table 7.

Table 7. Model Summary of the Regression Coefficients

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.925[a]	.856	.851	6.22004

Table 7 expresses that the R Square value is 0.856, which means that the influence of problem posing on students' self-efficacy abilities is 85.6%, and 14.4% is influenced by other variables that have not been studied.

Discussion

The results of the descriptive statistics in this study indicate that the average pre-test score of the experimental group (48.40) is higher than that of the control group (41.13). However, the normality test using the Shapiro-Wilk method shows that both datasets follow a normal distribution with significance values greater than 0.05 (experimental: 0.089; control: 0.154). Furthermore, the homogeneity of variance test using Levene's Statistic reveals that the data have homogeneous variance with a significance value of 0.360, which is also greater than 0.05. These statistical findings suggest that both groups had similar initial abilities before the treatment was applied. Consequently, the experimental and control groups were suitable for comparison, enhancing the validity of the study. This supports the internal validity of the research design, ensuring that the outcomes can be attributed to the implemented learning model [28].

Teacher activity observations indicate that the implementation of the Problem Posing model followed the syntax adapted from previous frameworks [29]. During the learning process, the teacher provided clear explanations with a high activity level, reaching 89.75%. The teacher also encouraged active student participation by posing challenging questions and guiding them to solve problems collaboratively. Additionally, students were asked to present their questions in front of the class (87.54%) and were assigned related homework tasks (97.35%). This high level of teacher involvement indicates a consistent and structured application of the Problem Posing model. Such teacher engagement is essential for maximizing the model's potential to enhance students' self-efficacy [30].

After the treatment, both experimental and control groups were again tested for normality and homogeneity to verify the assumptions of the analysis. The Shapiro-Wilk test results indicated that the final data remained normally distributed with significance values of 0.227 for the experimental group and 0.134 for the control group. Levene's test also confirmed the homogeneity of variance with a significance value of 0.360 (> 0.05), maintaining the assumption for ANOVA testing. The two-way ANOVA results showed a significant effect of the Problem Posing model on students' self-efficacy, with a p-value of 0.000 (< 0.05). Furthermore, the regression analysis revealed a beta coefficient of 0.925, which denotes a strong positive relationship between the model and students' self-efficacy. This demonstrates that the Problem Posing model effectively contributes to improving students' affective learning outcomes [31].

The regression analysis also showed that the Problem Posing model accounted for 85.6% of the variance in students' self-efficacy, as indicated by an R Square value of 0.856. This means that the majority of the improvement in self-efficacy could be explained by the implementation of this model. Meanwhile, the remaining 14.4% was attributed to other variables that were not examined in this study, such as student background, home environment, or alternative instructional strategies. The strength of this statistical relationship provides empirical evidence of the dominant effect of the Problem Posing model. These findings support the claim that learning strategies emphasizing active participation and critical thinking are essential in enhancing students' confidence in learning. It also implies that the model plays a substantial role in shaping students' learning attitudes and motivation [32].

This study is in line with previous research by Salviejo [33], which concluded that Problem Posing-based learning increases students' mathematical engagement and self-confidence in solving problems. Similarly, findings from Yurt [34] confirmed that students' self-efficacy is positively linked to their critical thinking and creativity skills. The results of the present study reinforce the relevance of the Problem Posing model in various educational contexts, particularly in promoting these essential student competencies. Moreover, the findings resonate with research conducted by Arifin et al. [35], emphasizing the importance of teacher feedback in fostering students' self-confidence. Overall, the consistent involvement of both students and teachers within the Problem Posing framework contributes to the development of a more effective and student-centered learning environment.

Conclusion

The results of this study indicate that the implementation of the Problem Posing learning model significantly enhances students' self-efficacy, particularly among students in the experimental class. This success is supported by the structured involvement of teachers in applying the model. Based on these findings, the Problem Posing model is deemed an

appropriate learning strategy to improve students' self-efficacy at Muhammadiyah Mlati Senior High School. The model's influence on students' self-efficacy was recorded at 85.6%, while the remaining 14.4% was attributed to other variables not examined in this study. These results highlight the importance of educational innovations that focus not only on cognitive achievement but also on affective aspects such as self-efficacy, which play a crucial role in supporting students' learning success.

Conflict of Interest

The authors declare that there is no conflict of interest.

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