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The Effect of the Guided Inquiry Learning Model on the Improvement of Students' Mathematical Problem-Solving Ability

Benazir Shafa Imani[1], Pentatito Gunowibowo[2], Santy Setiawati[3]
[1–3] Universitas Lampung, Indonesia
benazirshafaimani@gmail.com

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ABSTRACT Students' mathematical problem-solving ability remains relatively low, as reflected in their difficulties in understanding problems, connecting relevant concepts, and evaluating and drawing conclusions from their solutions. This study investigated the effect of the guided inquiry learning model on the improvement of students' mathematical problem-solving ability. A quasi-experimental method with a pretest-posttest control group design was employed. The population comprised 252 eighth-grade students at SMP Negeri 9 Bandar Lampung. Through purposive sampling, 26 students from class VIII-E were selected as the experimental group, while 28 students from class VIII-C were selected as the control group. Data were collected using a mathematical problem-solving ability test and analyzed using the Mann-Whitney U test. The results showed that students who participated in guided inquiry learning achieved greater improvement in mathematical problem-solving ability than those who participated in conventional learning. These findings demonstrate that the guided inquiry learning model has a significant effect on improving students' mathematical problem-solving ability.

Keywords: effect, mathematical problem-solving, guided inquiry

INTRODUCTION

Education plays a strategic role in improving the quality of human resources because it enables individuals to develop their potential optimally (Setyawan, 2025). In response to rapid developments and the demands of the digital era and Smart Society 5.0, education is expected to produce human resources who are adaptive, creative, and competitive (Siregar et al., 2024). Education not only functions to shape intellectually capable individuals but also plays a role in building a productive and innovative society. One effort to achieve this goal is through the implementation of structured formal education, in which mathematics is one of the compulsory subjects taught at every level of education. Mathematics learning is designed to develop various competencies, including conceptual understanding, reasoning, communication, and mathematical problem-solving ability. Mathematical problem-solving ability is a crucial competency, as it represents both the primary goal of mathematics learning and the core process within the mathematics curriculum (Sumartini, 2016). Through problem-solving ability, students are expected to apply mathematical concepts to solve problems both in academic contexts and in everyday life.

However, students' mathematical problem-solving ability is still relatively low. This is evident from the results of the Programme for International Student Assessment (PISA) in 2022, which indicate that Indonesian students' mathematics achievement remains below the international average (OECD, 2023). PISA problems require students to apply mathematical concepts to new and unfamiliar situations, making problem-solving and higher-order thinking skills essential (Bidasari, 2017). The low level of students' mathematical problem-solving ability is influenced by various factors, including differences in students' learning styles (Jahring & Chairuddin, 2019) and the lack of regular practice in solving problems systematically (Aini, 2014). This condition was also found at SMP Negeri 9 Bandar Lampung. A preliminary study involving 28 students found that 18 students experienced difficulties in understanding the problem, particularly in correctly identifying and writing down the given information and what was being asked. In addition, 12 students experienced difficulties in planning problem-solving strategies because they did not define variables or organize their solution steps systematically. Another 12 students did not recheck their answers, so errors in the solution process could not be corrected. Students also tended to perform calculations immediately without writing down the given information and what was being asked, so their solutions often did not align with the problem's objectives.

These student difficulties are consistent with the results of interviews and classroom observations, which indicate that mathematics learning is still predominantly teacher-centered. Students mostly receive information from the teacher and follow the provided examples, limiting their opportunities to develop independent thinking skills. Such learning patterns make students less accustomed to dealing with non-routine problems that require critical thinking and diverse problem-solving strategies. Therefore, a learning model is needed that actively involves students in the learning process, enabling them to construct their own knowledge through meaningful learning experiences. Learning that involves interaction between teachers and students, as well as among students, can help students better understand mathematical concepts and improve their mathematical problem-solving ability (Lubis et al., 2023).

One learning model that can address these needs is the guided inquiry learning model. This model provides opportunities for students to actively engage in the learning process through structured investigative activities, allowing them to discover concepts independently with guidance from the teacher (Lovisia, 2018; Nurmayani et al., 2018).

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The stages of the guided inquiry model include identifying problems, formulating hypotheses, conducting experiments or explorations, collecting and analyzing data, testing hypotheses, and drawing conclusions (Muliani & Wibawa, 2019). Through these stages, students are trained to understand problems, plan solutions, implement chosen strategies, and evaluate the results obtained. Thus, learning focuses not only on final outcomes but also on students' thinking processes in solving problems. Several previous studies have shown that the implementation of the guided inquiry learning model has a positive effect on improving students' mathematical problem-solving ability (Aristiani et al., 2018; Palajukan et al., 2021; Wahyuni et al., 2023). Together, these findings indicate that guided inquiry has the potential to enhance students' problem-solving ability through active engagement in the learning process.

Nevertheless, the implementation of the guided inquiry learning model requires further investigation, particularly among junior high school students with varying characteristics and in the context of linear equations and inequalities in one variable. In addition, limited research has examined mathematical problem-solving ability using a complete set of problem-solving indicators, namely understanding the problem, planning the solution, implementing the solution, and reviewing the results. Therefore, this study aims to determine the effect of the guided inquiry learning model on improving students' mathematical problem-solving ability.

RESEARCH METHOD

This quasi-experimental study involved a population of 252 eighth-grade students at SMP Negeri 9 Bandar Lampung. Purposive sampling was used because the selected classes were taught by the same teacher and had relatively similar mathematical abilities, as indicated by the average scores of the end-of-semester mathematics summative assessment. Based on these considerations, Class VIII-E, consisting of 26 students, was selected as the experimental class implementing the guided inquiry learning model, while Class VIII-C, consisting of 28 students, was selected as the control class implementing the conventional learning model.

The study used a pretest-posttest control group design and was conducted over five meetings. In the experimental class, learning activities were carried out using the guided inquiry learning model through the stages of orientation/problem identification, formulating hypotheses, designing and conducting experiments, collecting and analyzing data, testing hypotheses, and drawing conclusions. Meanwhile, in the control class, learning activities were conducted conventionally using the direct instruction approach through the stages of orientation, material presentation/knowledge delivery, guided practice, checking understanding & providing feedback, and independent practice.

Data were collected using an essay test designed to measure students' mathematical problem-solving ability. The test instrument comprised three items based on the indicators of mathematical problem-solving ability, namely understanding the problem, planning a solution, implementing the solution plan, and checking the results. Each student's answer was analyzed and scored according to the scoring rubric for each indicator. The resulting scores were then converted into percentages for each indicator. Before use, the test instrument was pilot-tested for validity, reliability, difficulty level, and discrimination index among students who were not included in the sample but had studied the tested material. The results of the analysis indicated that the test instrument was appropriate for use in the study.

The pretest and posttest scores were then used to calculate the gain in students' mathematical problem-solving ability in each class, allowing differences in improvement after the two learning treatments to be identified. Data processing and analysis were conducted using statistical tests on gain scores. The normalized gain (N-Gain) was calculated based on the formula proposed by Meltzer (2002):

$$g = \frac{\text{Posttest score} - \text{Pretest score}}{\text{Ideal score} - \text{Pretest score}}$$

Before hypothesis testing, prerequisite tests were performed to assess normality using the Chi-Square test and homogeneity using the F test. The results indicated that the mathematical problem-solving ability data were not normally distributed. Therefore, the Mann–Whitney U test was used to analyze students' mathematical problem-solving ability.

RESULTS AND DISCUSSION

The initial stage of data collection involved administering a pretest in both the experimental and control classes to determine students' baseline mathematical problem-solving ability. The data are presented in Table 2.

Table 2. Initial Data on Students' Mathematical Problem-Solving Ability

Class	Number of Students	Mean	Minimum Score	Maximum Score	Standard Deviation
Experimental	26	6,23	2	15	2,80
Control	28	4,82	1	13	3,04

Table 2 shows that the experimental class had a higher average initial mathematical problem-solving ability than the control class, with a difference of 1.41. The experimental class also demonstrated a higher maximum score.

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Following the pretest, the final mathematical problem-solving ability of students in both classes was assessed using a posttest. The resulting data are summarized in Table 3.

Table 3. Final Data on Students' Mathematical Problem-Solving Ability

Class	Number of Students	Mean	Minimum Score	Maximum Score	Standard Deviation
Experimental	26	19,27	9	25	4,28
Control	28	12,25	6	23	5,04

Table 3 indicates that the experimental class achieved a higher average final mathematical problem-solving ability than the control class, with a difference of 7.02. In addition, the experimental class obtained a higher maximum score.

To compare the changes between the two classes, gain data were calculated from the pretest and posttest results. The gain scores for the guided inquiry and conventional learning classes are presented in Table 4.

Table 4. Improvement in Students' Mathematical Problem-Solving Ability

Class	Number of Students	Mean	Minimum Score	Maximum Score	Standard Deviation
Experimental	26	0,55	0,09	0,79	0,162
Control	28	0,30	0,08	0,74	0,156

The data in Table 4 show that the experimental class achieved a higher average improvement in students' mathematical problem-solving ability compared to the control class. The Chi-Square normality test revealed that the gain scores in both the experimental class ($\chi^2_{\text{calculated}} = 10{,}69 > \chi^2_{\text{table}} = 7{,}81$) and the control class ($\chi^2_{\text{calculated}} = 11{,}51 > \chi^2_{\text{table}} = 7{,}81$) were not normally distributed. Therefore, the nonparametric Mann–Whitney U test was applied. The results are presented in Table 5.

Table 5. Mann--Whitney U Test Results on the Improvement of Students' Mathematical Problem-Solving Ability

Mean	Variance	$Z_{\text{calculated}}$	α	$-Z_{\text{table}}$	Test Result
364	57,76	-4,65	0,05	-1,64	H_0 rejected

Table 5 shows that, at a significance level of $\alpha = 5\%$, the value of $Z_{\text{calculated}}$ (-4,65) was lower than $-Z_{\text{table}}$ (-1.64), leading to the rejection of H_0. This result indicates that students taught using the guided inquiry learning model experienced a significantly greater median improvement in mathematical problem-solving ability than those taught using conventional methods.

Data on the achievement of mathematical problem-solving indicators and the percentage of achievement for each item in both the experimental and control classes are presented in Table 6.

Table 6. Data on the Achievement of Mathematical Problem-Solving Indicators

No	Indicators of Mathematical Problem-Solving Ability	Experimental		Control	
		Initial	Final	Initial	Final
1.	Understanding the problem	52%	88%	27%	54%
2.	Planning the solution	17%	90%	19%	61%
3.	Implementing the solution plan	6%	54%	14%	37%
4.	Reviewing the results	0%	17%	0%	6%

Table 6 demonstrates improvements across all indicators. For understanding the problem, the guided inquiry class improved by 36%, while the conventional class improved by 27%, resulting in a 9% advantage for guided inquiry. In planning the solution, the guided inquiry class improved by 73%, compared to 42% in the conventional class, with a difference of 31%. In implementing the solution plan, the guided inquiry class improved by 48%, while the conventional class improved by 23%, with a difference of 25%. For reviewing the results, the guided inquiry class improved by 17%, compared to 6% in the conventional class, with a difference of 11%.

Taken together, the hypothesis test and indicator-level results indicate that the guided inquiry model has a greater positive effect on improving students' mathematical problem-solving ability than conventional learning. This is evidenced by the higher median gain scores achieved by students in the guided inquiry class. These findings are consistent with those of Wahyuni et al. (2023) and Palajukan et al. (2021), who state that the guided inquiry learning model significantly influences the improvement of students' mathematical problem-solving ability.

To explain this improvement, the guided inquiry model actively involved students through several stages, including orientation or problem identification, hypothesis formulation, designing and conducting experiments, collecting and analyzing data, testing hypotheses, and drawing conclusions. All these stages were integrated into learning activities structured in Student Worksheets (LKPD). According to Maulida and Kusumadewi (2025), LKPD serves as a guide for students in understanding problem situations, constructing mathematical models, and ultimately finding solutions.

The first stage is orientation or problem identification, in which students are provided with guiding questions and problems in the LKPD to encourage them to understand the problem and identify the given and required information. At this stage, students

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are trained to comprehend problems independently and express their ideas. This aligns with Suparmi (2018), who states that the orientation stage trains students to understand the problems they face and express their ideas or opinions.

The second stage is hypothesis formulation. At this stage, students construct tentative assumptions based on the information obtained through group discussions, using mathematical symbols or representations as an initial plan for solving the problem. This is consistent with Wijayanti and Amin (2019), who state that mathematical representation in problem-solving involves the use of symbols and mathematical expressions to present solution ideas.

The third stage involves designing and conducting experiments or exploration. Students determine the strategies to be used in solving the problem, while the teacher acts as a facilitator, guiding and directing discussions to help students select appropriate strategies. This is in line with Aeni et al. (2017), who state that guided inquiry learning encourages students' active involvement in exploration and the application of problem-solving strategies.

The fourth stage is collecting and analyzing data. At this stage, students carry out systematic solution steps to obtain data used as a basis for verifying hypotheses, with guidance from the teacher. This is consistent with A'yunin et al. (2016), who state that teachers guide students in collecting the information necessary to test their initial assumptions.

The fifth stage is hypothesis testing. Students examine the validity of their tentative assumptions by comparing their solutions with the given problems to obtain accurate results. A'yunin et al. (2016) state that, during the hypothesis-testing stage, students carefully review their hypotheses to verify their correctness.

The sixth stage is drawing conclusions. Students formulate conclusions based on the results of group discussions, re-evaluate the solution steps, and present their findings to the class with guidance from the teacher to avoid misconceptions. At this stage, students are trained to evaluate their solution steps and relate their findings to the concepts learned.

Despite these advantages, several challenges were encountered during the implementation of the guided inquiry learning model. Students were not yet accustomed to collaborative learning, resulting in uneven participation, with higher-ability students tending to dominate. In addition, not all mathematical topics can be effectively taught through Student Worksheets (LKPD), particularly those requiring systematic procedural explanations; therefore, direct instruction may be needed as an alternative. Direct instruction aims to help students learn knowledge that can be explained step by step (Utari et al., 2020). Another challenge was students' low self-confidence, which affected their participation in presentations. To address this issue, the teacher motivated students to be more confident and unafraid of making mistakes when expressing their ideas and explained the key points that should be conveyed during presentations. This aligns with Fauziyah and Alrian (2025), who state that learning motivation determines the level of students' effort and participation in learning activities.

CONCLUSION AND SUGGESTIONS

The findings indicate that students who participated in guided inquiry learning achieved greater improvement in mathematical problem-solving ability than those who participated in conventional learning. Thus, the guided inquiry learning model has a significant effect on improving students' mathematical problem-solving ability. Its effective implementation requires careful instructional preparation and alignment between the learning model and the characteristics of the material. For topics that involve highly procedural content, such as solving systems of linear equations in two variables using elimination and substitution methods, direct instruction or demonstration may be used as complementary alternatives to help students understand each stage of the solution process more clearly.

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