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EFFECTIVENESS OF THE DISCOVERY LEARNING MODEL BY GEOBOARD ON PROBLEM-SOLVING ABILITIES OF FIFTH GRADE ELEMENTARY SCHOOL STUDENTS

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ABSTRACT

The goal of this study is to ascertain how successfully the Geoboard-assisted Discovery Learning approach affects fifth-grade elementary school students' problem-solving abilities in the field of planar figures. This study used a nonequivalent control group design and a quasi-experimental methodology. 21 students from SDN Kembangarum 2 made up the experimental group, and 29 students from SDN Kembangarum 1 made up the control group. The experimental group received instruction using the Geoboard-assisted Discovery Learning paradigm, while the control group received conventional training. Mathematical problem-solving tasks were used to gather data, and the Shapiro-Wilk normality test, Levene's homogeneity test, Independent Sample T-Test, and N-Gain Score were used for analysis. According to the findings, there was a 25.41-point difference between the experimental group's mean posttest score (70.62) and the control group's (45.21). With t = 5.245 and Sig. (2-tailed) = 0.000 < 0.05, H0 was rejected, according to the Independent Sample T-Test. Furthermore, there was a ±17.29% difference between the experimental group's N-Gain Score of 44.79% (medium category) and the control groups of 27.50% (low category).. These findings demonstrate that the Geoboard-assisted Discovery Learning model significantly and positively influences students' problem-solving abilities and is more effective than conventional instruction. The use of the Geoboard as a concrete manipulative medium enables students to experience Bruner's three stages of representation—enactive, iconic, and symbolic—thereby fostering deeper conceptual understanding and more optimal development of problem-solving skills.

Keywords: *Discovery Learning; Geoboards; Problem-Solving Ability; Plane Figure Area; Elementary School*

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BACKGROUND

Education is a deliberate and organized endeavor to establish a setting and educational process where pupils can actively realize their potential. This is in line with Law Number 20 of 2003's directive for the National Education System, which stipulates that national education must cultivate skills and mold a respectable national character. In facing the changing times, education must adapt to the demands of the 21st century.

In the 21st century, students are required to possess skills known as the *Partnership for 21st Century Skills* (P21), namely critical thinking and problem-solving , creativity , communication , and collaboration . According to Bernie Trilling and Charles Fadel (2009), these skills are crucial for facing global challenges. Therefore, learning in schools must be able to develop higher-order thinking skills, especially problem-solving skills.

One of the subjects that is essential to the development of these skills is mathematics. According to *the National Council of Teachers of Mathematics* (1989; 2000), mathematics learning objectives encompass five process standards: problem solving , reasoning *and proof* , communication , connections , and representation , as well as fostering an appreciation for mathematics. Therefore, mathematical problem-solving skills are a key competency that must be developed from elementary school.

However, Indonesian students' mathematical abilities remain low. Based on the Organization for Economic Co-operation and Development's (OECD) 2022 Programme for International Student Assessment (PISA), Indonesian students' mathematical literacy remains below the average for OECD member countries. Furthermore, the *Trends in International Mathematics and Science Study* (TIMSS) also shows that students' ability to solve problems requiring reasoning and problem-solving is still relatively low. This suggests that pupils' capacity to solve mathematical puzzles has not yet reached its full potential.

Based on initial observations in fifth grade elementary school (SD), students still experience difficulties in solving problems related to the area of flat shapes, especially word problems that require an understanding of the information provided and the ability to develop problem-solving strategies. They frequently concentrate on formulas without considering the context of the issue, which makes it challenging to apply ideas flexibly. Students' low mathematical problem-solving abilities are influenced by several factors. First, learning is still teacher -*centered* , so students are less active in discovering concepts. Second, learning tends to emphasize memorizing formulas and practicing routine problems, so students experience difficulties in solving non-routine problems. Third, pupils find it challenging to comprehend abstract mathematical concepts when concrete learning materials are not used. This is supported by various previous research results.

Research by Syifah & Maharbid (2025) shows that elementary school students' problem-solving abilities are still low because learning does not actively involve students. The study's findings suggest that using the Discovery Learning methodology can help students become more adept at solving mathematical puzzles. According to Ramadhani et al. (2023) , students' mathematical problem-solving

abilities are still low and can be improved through innovative learning models. The results of this study indicate that the media-assisted *Discovery Learning model* has a positive influence on students' problem-solving abilities.

Kurino et al., (2024) discovered that, in comparison to traditional learning, the Discovery Learning paradigm significantly improved pupils' capacity to solve mathematical problems. Additionally, Lubis et al., (2019) found that a lack of conceptual knowledge makes it difficult for pupils to solve mathematical issues. Guided exploration learning has the potential to significantly improve the ability of students to solve problems.

According to the study's findings, students' poor mathematical problem-solving skills are a result of their inadequate use of creative learning models and their scant use of tangible learning resources. One of the mathematical materials that requires problem-solving abilities is the area of a plane figure. Students must comprehend concepts through investigation and visual aids in addition to memorizing formulas. Consequently, a learning approach that can actively involve pupils is required. One learning model that can be used is *Discovery Learning* , a learning model that emphasizes the process of discovery so that students can construct their own knowledge. Students' critical thinking and quantitative problem-solving skills can be enhanced by this approach.

In addition to learning models, media use is essential, especially for students at elementary school in the concrete operational stage. A geoboard is a concrete tool that may be used to assist children envision flat forms and directly comprehend the idea of area. According to the description, using the Discovery Learning approach in conjunction with geoboard media has the potential to enhance students' mathematical problem-solving skills, particularly when it comes to the subject of flat shapes. Thus, a study named " Effectiveness of The Discovery Learning Model by Geoboard on Problem-Solving Abilities of Fifth Grade Elementary School Students" is of interest to scholars. This research is expected to contribute to the development of mathematics learning that is in line with the demands of 21st-century competencies and the objectives of mathematics learning according to NCTM.

RESEARCH METHODS

Research Approaches and Types

This study employed a quantitative methodology. A quantitative approach is a type of research methodology that uses numerical data collecting and analysis to examine theories and hypotheses. In this approach, researchers use standardized instruments to objectively measure certain variables. The primary goal is to determine the relationships or influences between variables through systematic, measurable, and statistically testable procedures.

In this study, observation sheets were used to evaluate students' teamwork abilities, and any statistically significant differences between the experimental and control groups were analyzed. Therefore, the quantitative approach in this study served as the basic framework for developing the research design, data collection techniques, and data analysis, all of which were aimed at examining the effect of innovative learning approaches on elementary school students' collaborative abilities.

This study employed a quasi-experiment research design. *Quasi-experiments* are used because in the context of elementary school education, it is not possible to completely *randomize* students into experimental and control groups. Consequently, the established classes are used as research subjects. The Discovery Learning method was used in this study to teach mathematics to the experimental class using Geoboard. Meanwhile, the control group was taught mathematics using conventional methods such as lectures and practice problems.

Design Used: *Nonequivalent Control Group Design* , as follows:

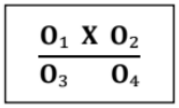


Figure 1. Nonequivalent Control Group Design

Information :

O_1 and O_3 = *Pretest* (initial problem solving ability)

X = Treatment (*Discovery Learning* + Media *Geoboard*)

O_2 and O_4 = *Posttest* (final problem solving ability)

The researcher created two groups, the experimental group and the control group, using the Nonequivalent Control Group Design method. Prior to the commencement of the learning process, each student took a pretest to ascertain their starting ability. Both groups were confirmed to have relatively homogeneous characteristics based on the pretest results in the aspect of mathematical reasoning abilities. After the pretest was implemented, While the control group was taught using a traditional learning model, the experimental group was treated by applying the discovery learning model with the help of geoboard media. A posttest using the same instrument as the pretest was administered to both groups following the treatment. The pretest and posttest data from each group were then analyzed to compare the effects of the treatments given.

Table 1. Comparison of Random experimental class with Random control class

Group (R)	Pre-test	Independent Variable	Post-test
(R) E	Y1	X	Y2
(R) K	Y1	-	Y2

Information:

RE : Random experimental class

RK : Random control class

Y1: Initial test (*pretest*) before treatment is given

Y2: Final test (*posttest*) after treatment is given

X: Treatment in the form of a *Discovery Learning model assisted by Geoboard* media

In this research design, subjects were divided into two groups, namely the experimental class (RE) and the control class (RK) which were selected randomly. Both groups received distinct treatments: the control group (RK) learned using a conventional learning model without any additional support, while the experimental class (RE) received treatment (X) in the form of using the Discovery Learning model with the use of Geoboard media. Before the intervention was carried out, both groups were given a pretest (Y1) to evaluate the equality of the average initial abilities, particularly in pupils' capacity for problem-solving. After the learning ended, students

from both groups underwent a posttest (Y2) with the same instrument, even though they employed the Area of Flat Shapes material, to examine the variations in the enhancement of problem-solving skills due to the various treatments administered.

Data source

The data sources in this study were: fifth grade students of SDN Kembangarum 02 as the experimental group, fifth grade students of SDN Kembangarum 01 as the control group, fifth grade teachers of SD Gugus Ngudi Rahayu, Mranggen District, Demak Regency as supporting sources who provided information about class conditions and learning implementation.

These data sources were selected because they had relevant population characteristics, followed the same curriculum, and were willing to cooperate in conducting the research.

Data Collection Instruments

Table 2. Data Collection Instruments

Technique	Instrument	Form
Test	Math Story Problems	Essay test (Area of a Plane Shape)
Non-test	Observation of Problem Solving Ability	Observation sheet (teacher/researcher as observer)
Non-test	Problem Solving Ability Questionnaire	Likert scale 1–4
Non-test	Documentation	Secondary data that supports primary data from tests and observations

Data Analysis Techniques

A normality test was employed to determine if the pretest and posttest score distributions in the experimental and control groups were normally distributed. To use parametric analysis, such the t-test, this test is necessary. The Shapiro-Wilk test was used in this study since the sample size was less than fifty. The data were deemed to be normally distributed if the significance value (Sig.) was greater than 0.05. Both before and after the learning intervention, the outcomes of the students' problem-solving abilities test on the area of a plane figure were used for this process.

The homogeneity test aims to determine whether two data groups (the experimental class and the control class) have the same variance. This test is important to ensure that both groups have equivalent initial conditions so that the final results are unbiased. Levene's Test in SPSS software is used to conduct the homogeneity test. The data is deemed homogenous if the Levene's Test significance value is greater than 0.05. Before moving on to the mean difference and N-Gain tests, this homogeneity test is required.

A t-test (Independent Sample T-Test) was employed to ascertain whether there was a significant difference between the experimental and control groups' problem-solving skills in mathematical word problems pertaining to plane figures. Because the data came from two distinct and independent groups, this test was utilized. The basic formula for the t-test is as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Information:

X^-_1, X^-_2 = average of experimental and control groups

S_1^2, S_2^2 = variance of each group

n_1, n_2 = number of samples in each group

The analysis's findings will demonstrate whether using the Discovery Learning methodology with Geoboard material is superior to traditional approaches.

The N-Gain test was used to assess how much the experimental class's pupils' problem-solving skills increased following the implementation of the treatment. This exam determines the degree of progress by calculating the difference between pretest and posttest scores. The N-Gain formula is as follows:

$$\text{N-Gain} = \frac{(Skor\ Posttest - Skor\ Pretest)}{(Skor\ Maksimal - Skor\ Pretest)}$$

The N-Gain interpretation criteria are:

N-Gain > 0.7 = high

0.3 < N-Gain ≤ 0.7 = moderate

N-Gain ≤ 0.3 = low

This exam enables researchers to assess how well the learning intervention enhances fifth-grade pupils' ability to solve problems involving flat shapes.

RESULTS AND DISCUSSION

Results

This research is a *quasi-experimental research* conducted in grade V involving two groups, namely the experimental class at SDN Kembangarum 2 and the control class at SDN Kembangarum 1. The experimental class (n = 21 students) received education using the Discovery Learning model with support from Geoboard media, whereas the control class (n = 29 students) received instruction using the conventional paradigm. The material taught in both classes is the Area of Flat Shapes.

Students in both classrooms took a pretest to gauge their problem-solving skills prior to the treatment. After the therapy was administered, both classes performed a posttest to determine their ultimate problem-solving abilities. According to the statistics collected, both classes saw an average growth. The experimental class's growth was higher than the control group's, suggesting that the application of the Discovery Learning model with the help of Geoboard media improved students' capacity for problem-solving.

In order to use parametric statistical tests, to determine if the gathered data were regularly distributed, a normality test was run. The Shapiro-Wilk test with a significance level of α = 0.05 was used for the normality test because each class had fewer than fifty samples. The data were considered normally distributed if the Sig. value was greater than 0.05, and non-normally distributed if the Sig. value was less than 0.05.

Tests of Normality

	Kelas	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Hasil	Pretest Kontrol	.156	29	.069	.931	29	.057
	Posttest Kontrol	.106	29	.200*	.964	29	.421
	Pretest Eksperimen	.165	21	.141	.962	21	.561
	Posttest Eksperimen	.102	21	.200*	.970	21	.736

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 2. Results of Normality Test using SPSS

The experimental class's Sig. value for pretest and posttest data was 0.561 and 0.736, respectively, according to the findings of the Shapiro-Wilk normality test. The control group's pretest and posttest Sig. values were 0.057 and 0.421, respectively. It is possible to conclude that the pretest and posttest data in the experimental and control

classes are normally distributed because all Sig. values are greater than 0.05. Thus, the normality requirements for the use of parametric statistical tests have been met.

To ascertain whether the data variance from both groups (the experimental and control classes) was homogeneous, a homogeneity test was employed. Levene's Test with a significance level of $\alpha = 0.05$ was utilized for the homogeneity test. The criterion for making decisions was that the data variance was homogeneous if the Sig. value was more than 0.05.

Table 3. Results of the Homogeneity Test of Pretest Questions using SPSS

Test of Homogeneity of Variance

		Levene Statistics	df1	df2	Sig.
Mark	Based on Mean	1,451	1	48	.234
	Based on Median	1,464	1	48	.232
	Based on Median and with adjusted df	1,464	1	46,711	.232
	Based on trimmed mean	1,389	1	48	.244

Table 4. Results of the Homogeneity Test of Posttest Questions using SPSS

Test of Homogeneity of Variance

		Levene Statistics	df1	df2	Sig.
Mark	Based on Mean	.560	1	48	.458
	Based on Median	.455	1	48	.503
	Based on Median and with adjusted df	.455	1	46,932	.503
	Based on trimmed mean	.569	1	48	.454

Levene's Test results for homogeneity reveal a Sig. 0.306 (Based on Mean). Since this number is higher than 0.05 (Sig. 0.306 > 0.05), it may be said that both classes' data variance is homogenous. This indicates that both groups' variances are equal, fulfilling the prerequisites for the use of parametric statistical tests and allowing the analysis to move on to the hypothesis testing phase.

An independent sample t-test was used to evaluate the hypothesis. Students in the experimental class using the Discovery Learning paradigm with Geoboard media support and those in the control class using traditional learning had dramatically different problem-solving abilities. The following statistical hypotheses were examined:

H_0 : $\mu_1 = \mu_2$ (There is no discernible difference in the problem-solving skills of the students in the experimental and control groups.)

H_1 : $\mu_1 \neq \mu_2$ (The problem-solving skills of the students in the experimental class and the control class are very different.)

Table 5. Findings from the independent sample t-test for the Experimental and Control courses' pretest questions using SPSS

Group Statistics

	Class	N	Mean	Standard Deviation	Std. Error Mean
Mark	Pretest Control	29	24.93	15,789	2,932

	Experiment Pretest	21	51.52	19,760	4,312

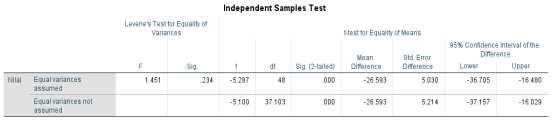


Figure 3. Findings from the independent sample t-test for the Experimental and Control courses' pretest questions using SPSS

The independent sample t-test yielded a t-count value of 5.287 and a Sig. (2-tailed) value of 0.000. With a significance level of 5% and a Sig. value of 0.000 <0.05, the absolute value of t-count (5.287) is higher than the t-table at df = 48. Consequently, H_0 is refused and H_1 is approved, suggesting that students in the experimental class and the control class have quite different problem-solving abilities. The experimental class's average pretest score of 51.52 is greater than the control class's score of 24.93, indicating that the Discovery Learning paradigm and the use of Geoboard media have significantly improved students' problem-solving abilities.

Table 6. Findings from the independent sample t-test on the posttest questions for the experimental and control groups using SPSS

Group Statistics

	Class	N	Mean	Standard Deviation	Std. Error Mean
Mark	Posttest Control	29	45.21	15,855	2,944
	Experiment Posttest	21	70.62	18,282	3,990

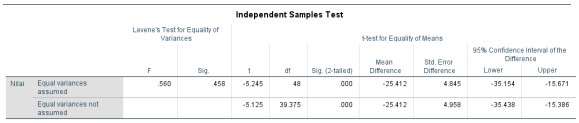


Figure 4. Results of the independent sample t-test on the posttest questions using SPSS for the Experimental and Control groups

A t-count value of 5.245 and a Sig. (2-tailed) value of 0.000 were obtained from the independent sample t-test. The absolute value of the t-count (5.245) is greater than the t-table at df = 48 at a significance level of 5% and a Sig. value of 0.000 <0.05. Consequently, H_0 is refused and H_1 is approved, suggesting that students in the experimental class and the control class have quite different problem-solving abilities. The average posttest score for the experimental group was 70.62, higher than the 45.21 for the control group. demonstrating that students' problem-solving skills have been much enhanced by the Discovery Learning paradigm with the use of Geoboard media.

N-Gain test is used to measure the effectiveness of the treatment given in improving students' problem-solving abilities. *N-Gain is computed by dividing the difference between the maximum score and the pretest score by the difference between the posttest and pretest scores. The following standards are used to classify effectiveness: N-Gain < 0.30 (low), 0.30 ≤ N-Gain < 0.70 (moderate), and N-Gain > 0.70 (high).*

Table 7. N-Gain Score Test Results

Descriptives

	Class		Statistics	Std. Error
N-gain percent	CONTROL	Mean	27.4993	2.59163
		Standard Deviation	13.95635	
		Minimum	5.48	
		Maximum	75.00	
	EXPERIMENT	Mean	44.7916	5.02100
		Standard Deviation	23.00909	

	Minimum	18.97
	Maximum	100.00

The average N-Gain for the experimental class was 44.79%, which falls into the medium range (0.30 ≤ N-Gain < 0.70) according to the N-Gain computation. The average N-Gain for the control group, on the other hand, was 27.50%, which is in the low range (N-Gain < 0.30). Although both are not in the top category, the N-Gain difference of ±17.29% between the experimental class and the control class indicates that the Discovery Learning model, with the aid of Geoboard media, is more successful in improving students' problem-solving skills than traditional learning.

Discussion

Problem Solving Ability of Experimental Class and Control Class

The data analysis revealed that following the learning process, students' problem-solving skills improved in both the experimental and control groups. But compared to the control class, the experimental class's improvement was consistently higher and more noteworthy. Even though the initial ability conditions of both classes revealed that the experimental class had a pretest average of 51.52 and the control class had a pretest average of 24.93, this is clear from the experimental class's posttest average of 70.62, which is higher than the control class's posttest average of 45.21.

One of the higher-order thinking skills that kids must acquire in the twenty-first century is the ability to solve problems. In the theory of Discovery Learning , Bruner (1961) stated that the learning process will be more meaningful if students are actively involved in discovering concepts or principles themselves through direct experience. In this context, the *Discovery Learning model* is fully designed to position students as active subjects who solve problems independently or in groups with the help of *Geoboard media* , so that their problem-solving abilities can develop optimally.

Students in the control class, on the other hand, were positioned more as passive recipients of knowledge from the teacher due to the usage of conventional learning. Interactions were still dominated by teacher instruction, thus under-stimulating students' problem-solving abilities. This aligns with Bruner's view that learning that does not involve the active process of constructing knowledge will result in shallow and short-lived understanding.

The experimental class's and the control class's problem-solving skills differed significantly, according to the posttest data analysis results acquired after the therapy was administered. The control group, which employed traditional instruction, received a posttest average of 45.21 with a standard deviation of 12.88 and a total of 29 students, while the experimental group, which used the Discovery Learning model with assistance from Geoboard media, received a posttest average of 70.62 with a standard deviation of 10.62 and a total of 21 students. After the therapy, the experimental class's problem-solving skills were superior to those of the control group, as evidenced by the average difference of 25.41 points.

To prove the difference statistically, an *independent sample t-test was conducted*.

Levene's Test for Equality of Variances was examined before the t-test findings were interpreted. A significant value of 0.458 > 0.05 was found using Levene's Test on the posttest data, indicating that both groups' data variance is homogeneous. As a result, the Equal variances assumption row is used to interpret the t-test findings. The computed t-value for that row was 5.245, and the significance value (2-tailed) was 0.000. It can be inferred that there was a significant difference between the experimental class's and the control class's problem-solving skills following the treatment because the significance value of 0.000 < 0.05 led to the rejection of H_0 and the acceptance of H_1.

The findings of this study are consistent with research by Ramadhani et al., (2023), which demonstrated a notable improvement in problem-solving skills in the experimental class, where students were able to recognize information in questions, employ suitable strategies, and achieve superior outcomes in comparison to traditional learning. Furthermore, Yustinaningrum et al., (2022) demonstrated that the Discovery Learning model was superior to other models since students were able to solve problems using more methodical and logical procedures. Therefore, it was demonstrated that using the Discovery Learning model in conjunction with Geoboard media could significantly improve the experimental class's and the control class's problem-solving skills when it came to the subject of flat shapes in grade V elementary school.

The Effect of Geoboard-Assisted Discovery Learning Model on Problem-Solving Ability

The use of the Discovery Learning approach with the help of Geoboard media has a substantial impact on fifth-grade students' problem-solving skills on the Area of Flat Shapes material, according to the results of the Independent Sample t-test. The Sig. (2-tailed) value of 0.000, which is less than 0.05, demonstrates this, indicating that H_0 is rejected and H_1 is accepted. The conclusion that there is a genuine and statistically significant influence is further supported by the fact that the t-count value of 5.245 is also higher than the t-table at df = 48 with a significance level of 5%.

Several learning mechanisms can be used to describe how the Geoboard-assisted Discovery Learning approach improves students' problem-solving skills. First, the use of *Geoboard media* allows students to directly visualize flat shapes, making the concept of area easier to understand. This is in accordance with the enactive stage in Bruner's representation theory which emphasizes the importance of learning through direct experience and manipulation of real objects. Second, the structured *Discovery Learning syntax starting from stimulation* , *problem statement* , *data collection* , *data processing* , *verification* , to *generalization* systematically trains each dimension of students' problem-solving abilities based on Polya's stages. Third, this model positions students as active subjects who discover concepts independently, so that the understanding gained is more meaningful and can be applied in solving contextual story problems.

It may be inferred from the independent sample t-test and N-Gain Score data that the *Discovery Learning model assisted by Geoboard* media has a significant influence on the problem-solving ability of the area of flat shapes in fifth grade elementary school students. This is

evidenced by two complementary analysis results, namely the results of *the independent sample t-test* which showed a significant difference between the two classes, as well as the N-Gain Score data, which demonstrated the extent of each class's rise.

The independent sample t-test for the posttest data produced a significance value (2-tailed) of 0.000 and a t-count value of 5.245. At a significance level of 5% and a significance value of 0.000 <0.05, the absolute value of the t-count (5.245) is higher than the t-table at df = 48. As a result, When H_0 is approved and H_1 is refused, it means that students' problem-solving skills are significantly impacted by the use of the Discovery Learning approach with the use of Geoboard media.. The experimental class obtained a posttest average of 70.62, while the control class only obtained a posttest average of 45.21, with a difference of 25.41 points reflecting the real superiority of the experimental class over the control class.

Based on the results of the N-Gain calculation, the average N-Gain of the experimental class was 44.79%, which falls into the medium category ($0.30 \leq$ N-Gain < 0.70). Meanwhile, the average N-Gain of the control class was 27.50%, which falls into the low category (N-Gain < 0.30). The N-Gain difference of ±17.29% although the experimental class is not yet in the high category, the comparison between the experimental class and the control class indicates that the Discovery Learning model with the use of Geoboard media is more effective than traditional learning in enhancing pupils' capacity to solve problems. The features of the Discovery Learning approach, which encourages students to actively discover concepts independently through a sequence of exploration and discovery activities, help to explain this strong influence. In this process, the *Geoboard media* acts as a concrete bridge that helps students visualize the concept of the area of a plane figure directly, so that students do not only memorize formulas but truly understand the meaning behind the concepts being learned. This is consistent with Bruner's theory of learning which emphasizes that meaningful learning occurs when students go through the enactive, iconic, and symbolic stages sequentially. Through the *Geoboard media* , students in the experimental class experienced these three stages in real time, namely manipulating a nailed board as the enactive stage, depicting the formed plane figure as the iconic stage, and calculating the area using formulas as the symbolic stage, so that students' problem-solving abilities developed more optimally.

The results of this study are in line with the research of Syifah & Maharbid, (2025) which proved that students who learned using *Discovery Learning* experienced significant improvements in understanding problems, planning strategies, and solving problems logically compared to the control class. In addition, research by Destiara et al., (2023) also confirmed that *Geoboard media* significantly improved students' problem-solving abilities because it helped students understand the concepts of area and perimeter in a more concrete and interesting way. Furthermore, research by Mulia et al., (2025) proved that *Geoboard media* helped students understand the concept of area visually so that students could more easily solve problems related to flat shapes. Therefore, compared to traditional learning on the subject of flat shapes in grade V elementary school, the combination of the

Discovery Learning model and Geoboard media has been shown to have a considerable and more effective influence on improving pupils' capacity to solve problems.

Improving Problem-Solving Skills Reviewed from the Implementation of the Discovery Learning Model Assisted by Geoboard Media

The average N-Gain of the experimental class was 44.79%, falling within the medium category ($0.30 \leq$ N-Gain < 0.70), according to the N-Gain computation findings. In contrast, the control class's average N-Gain was 27.50%, falling into the low category (N-Gain < 0.30). The N-Gain difference of ±17.29% between the control group and the experimental group suggests that the Discovery Learning model, with the help of Geoboard media, is more successful in enhancing students' problem-solving skills than traditional learning, even though the experimental class is not yet in the high category.

The experimental class's average N-Gain has not yet attained the high category (≥ 0.70), however this circumstance can be explained by a number of factors. First, the limited number of meetings during students were not yet completely acclimated to the grammar of the study due to its implementation the *Discovery Learning model* which requires an adaptation process. Second, the existence of a fairly large variation in initial abilities in the experimental class (SD pretest = 12.74) indicates that students have diverse knowledge backgrounds, so that uniform treatment cannot optimally raise all students. Third, the material on the area of a plane figure has a fairly high conceptual complexity, so it requires a longer exploration time with *Geoboard media* . These limitations can be used as evaluation material for further research.

Overall, the results of this study provide strong empirical evidence that the implementation of the *Discovery Learning model assisted by Geoboard* media has a positive and significant effect on the problem-solving abilities of fifth-grade students in the topic of Area of Flat Shapes. This model has proven to be more effective than conventional learning and can be used as an alternative innovative learning model for teachers in improving the quality of mathematics learning in elementary schools.

The average pretest and posttest scores for each class show how much students' problem-solving skills have improved, and the results of the N-Gain Score calculation, which shows how much improvement occurs proportionately to the students' initial conditions, reinforce this conclusion.

The average score on the pretest was 51.52 in the experimental class that used the Discovery Learning model with help from Geoboard media, and it increased by 19.10 points to 70.62 in the posttest. In contrast, the average pretest score of 24.93 rose to 45.21 on the posttest in the control group that employed traditional learning, a difference of 20.28 points. Although the difference in absolute increase between the two classes does not seem too far, it should be noted that the initial ability conditions of the two classes are quite different (pretest difference = 26.59 points). Therefore, a more objective measurement of the effectiveness of the increase is carried out through the N-Gain Score which takes into account the initial conditions of each class.

An N-Gain Score calculation was carried out by taking into account the starting conditions of each class in order to more objectively and proportionately gauge the extent of improvement. The average N-Gain for the experimental class was 44.79%, falling into the middle group ($0.30 \leq$ N-Gain < 0.70), while the average N-Gain for the control class was 27.50%, according to the computation findings. being classified as low (N-Gain < 0.30). This indicates that when contrasted proportionately to the students' initial conditions, the experimental class improved at a more optimal rate than the control class. In addition to raising students' absolute scores, the Discovery Learning approach with the help of Geoboard media was able to promote a more proportionate improvement when considering the starting skills of each class.

Being categorized as low (N-Gain $<$ 0.30). When compared proportionately to the students' baseline conditions, this suggests that the experimental class improved at a more optimal rate than the control class. When taking into account the beginning skills of each class, the Discovery Learning technique with the use of Geoboard media was able to encourage a more proportionate improvement in addition to boosting students' absolute results.

The Discovery Learning paradigm, which offers an engaging, purposeful, and student-centered learning experience, is inextricably linked to the notable rise in the experimental class, which attained an N-Gain of 44.79%. Through stages of *Discovery Learning* such as stimulation, problem identification, data collection, data processing, proof, and drawing conclusions, students are trained to think critically and systematically in solving problems. The involvement of *Geoboard media* in the process further strengthens the improvements that occur, because students can directly manipulate and explore the concept of area of flat shapes through concrete objects, so that the understanding formed is deeper and problem-solving skills develop significantly.

The findings of this study are consistent with research by Dwikasari et al., (2024), which demonstrated that the use of Geoboard-assisted Discovery Learning increased learning completeness by up to 80.77% because students were better able to comprehend the idea of the area of a plane figure through direct visualization. In addition, research by Wulandari et al., (2025) also proved that learning completeness increased from 80% to 90% through the combination of the *Discovery Learning model* and *Geoboard media* , where students showed a better understanding of the concept and were more active in learning. Furthermore, research by Kurino et al., (2024) confirmed that students in the *Discovery Learning class* had higher problem-solving abilities, as seen from the increase in test scores and students' ability to think critically and systematically organize problem-solving steps. Thus, the magnitude of the experimental class's greater improvement in problem-solving skills compared to the control group further demonstrates that the Discovery Learning approach with Geoboard support is an effective teaching strategy for fifth-grade elementary school pupils studying the area of a plane figure.

Comparison of Pretest to Posttest Values in Terms of N-Gain Score

The comparison of pretest to posttest scores reviewed from *the N-Gain Score* aims

to determine how much effectiveness each class's improvement in pupils' problem-solving skills is proportionately. In order to determine the N-Gain Score, which takes into account the initial conditions of the students, the difference between the posttest and pretest scores is divided by the difference between the maximum score and the pretest score. The following criteria are used to categorize effectiveness: N-Gain < 0.30 (low), 0.30 ≤ N-Gain < 0.70 (moderate), and N-Gain ≥ 0.70 (high).

The N-Gain Score calculation, the experimental class that implemented the *Discovery Learning model assisted by Geoboard* media experienced an increase from a pretest average of 51.52 to a posttest average of 70.62, resulting in an N-Gain of 44.79% which is included in the medium category. Meanwhile, the control class that used conventional learning experienced an increase from a pretest average of 24.93 to a posttest average of 45.21, resulting in an N-Gain of 27.50% which is included in the low category. The N-Gain of the experimental class and the control class differ by 17.29%, which is a very noticeable difference. This discrepancy demonstrates that the experimental class's rate of improvement in problem-solving skills from the beginning to the completion of learning was much higher than that of the control group.

A closer look reveals that the experimental class's N-Gain of 44.79% is in the middle of the medium category range, whereas the control class's N-Gain of 27.50% is in the low category and falls short of the medium category's bottom limit (0.30 or 30%). This suggests that the experimental class's quality of improvement was much better than that of the control group. This distinction further demonstrates that, in comparison to traditional learning, the Discovery Learning approach supported by Geoboard media contributes more to the growth of students' problem-solving skills.

The findings of this study are consistent with research by Mulia et al., (2025), which demonstrates that Geoboard media improves learning outcomes and makes it easier for students to solve problems with flat shapes by helping them visualize the idea of area. Additionally, research by Haryanto et al., (2025)demonstrates that discovery-based learning greatly improves students' problem-solving skills, making them more engaged, highly curious, and capable of solving issues on their own and methodically. Therefore, compared to traditional learning on the subject of flat shapes in grade V of elementary school, the Discovery Learning model supported by Geoboard media has been shown to be more effective in fostering an increase in students' problem-solving abilities from the initial conditions to the end of learning. This is based on the N-Gain Score.

Factors Causing the Experimental Class to Outperform the Control Class

The independent sample t-test results showed that the experimental class outperformed the control class in the area of a plane figure problem-solving skill (t-count = 5.245; Sig. = 0.000) and *N-Gain Score (44.79% vs. 27.50%), cannot be isolated from a number of elements that contribute to the success of using the Discovery Learning paradigm with Geoboard media*. These factors can be described as follows.

First, the *Discovery Learning model* encourages active student involvement in the learning process. Unlike conventional

learning, which places students as passive recipients of information, through a series of methodical steps, including stimulation, problem identification, data collection, data processing, proof, and conclusion drawing, the Discovery Learning model gives students the chance to actively explore, investigate, and discover the concept of area of a plane figure.. Active student involvement in this discovery process encourages a deeper and more meaningful understanding of the concept, thus optimally developing students' problem-solving abilities. This is in line with Bruner's learning theory, which emphasizes that the most effective learning occurs when students are actively involved in the discovery process and construct their own knowledge through direct experience.

Second, the use of *Geoboard media* provides a concrete and visual learning experience. *Geoboard media* , as a nailed board, allows students to directly manipulate and form various plane figures using rubber bands, so students can visualize the concept of area of plane figures in real life and not just imagine it abstractly. This concrete learning experience is in line with Bruner's learning theory, which emphasizes the importance of the enactive stage in the learning process, where students learn through direct manipulation of concrete objects before moving on to more abstract representations. Through *Geoboard* , students in the experimental class experienced all three stages of Bruner's representation sequentially: manipulating the nailed board as the enactive stage, depicting the formed plane figure as the iconic stage, and calculating the area using a formula as the symbolic stage. This makes the conceptual understanding of students in the experimental class much stronger than the control class. This finding is supported by research by Sabil et al., (2021) , which proved that the use of *Geoboard media* significantly improves the understanding of the concept of plane figures, because students find it easier to visualize shapes and understand the concept of area, which influences the development of mathematical problem-solving skills.

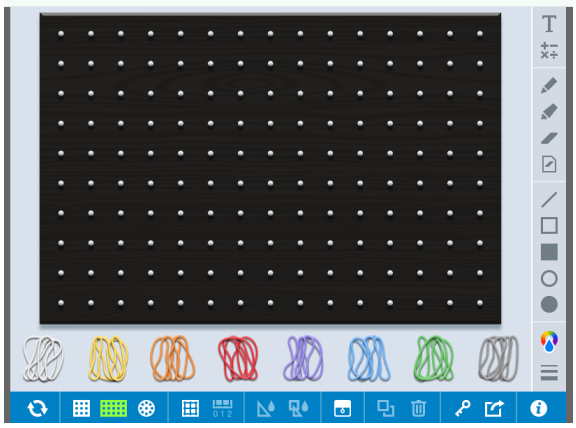


Figure 5. Geoboard Media

Third, the combination of *the Discovery Learning model* and *Geoboard media* can increase student motivation and active participation in learning. The hands-on and fun exploration activities using Geoboard *make students* more enthusiastic and interested in participating in learning, thereby increasing their curiosity and encouraging them to be more active in solving the problems given. This high learning motivation ultimately has a positive impact on students' problem-solving abilities. This is in line with research by Corketta & Hastings (2020) , which shows that students who learn with a discovery-based approach experience significant improvements in critical thinking and problem-solving skills, while also increasing their learning motivation.

Fourth, the Discovery Learning approach teaches students how to approach

problem-solving critically and methodically. Students become accustomed to recognizing issues, gathering pertinent information, analyzing data, demonstrating theories, and coming to their own conclusions as they progress through the phases of Discovery Learning. Students' problem-solving skills are immediately trained and developed by this methodical thought process, enabling them to apply principles in novel problem scenarios in addition to answering previously taught problems.

This is proven by research by Kurup et al., (2017) which shows that students who learn with the *discovery approach* experience significant improvements in problem-solving abilities, are more active, have high learning motivation, and are able to apply concepts in real situations. Thus, these four factors together are the main reasons why the experimental class that implemented the *Discovery Learning model assisted by Geoboard* media was able to outperform the control class in problem-solving abilities regarding the area of flat shapes in grade V of Elementary School.

CONCLUSION

Based on the research results and discussions outlined in the previous chapter, several conclusions can be drawn as follows.

Students in both the experimental and control groups became more adept at solving problems following the learning process. The experimental class, which implemented the *Discovery Learning model with the aid of Geoboard* media, achieved an average pretest score of 51.52 and increased to 70.62 in the posttest. The control class, which used conventional learning, achieved an average pretest score of 24.93 and increased to 45.21 in the posttest. Although the absolute difference in improvement between the two classes did not appear to be significant, the average posttest score of the experimental class (70.62) was still higher than the control class (45.21), with a difference of 25.41 points. This indicates that the improvement that occurred in the experimental class was consistently more significant when viewed from the final student achievement.

Fifth-grade elementary school students' problem-solving skills on the Area of Plane Region content are significantly impacted by the use of the Discovery Learning approach with the use of Geoboard media. According to the Shapiro-Wilk test (all Sig. values > 0.05) and Levene's test (Sig. pretest = 0.234 > 0.05; Sig. posttest = 0.458 > 0.05), the pretest and posttest data in both classes satisfy the parametric test requirements. The results of *the Independent sample t-test* on the posttest data show a t-count value of 5.245 with a Sig. value (2-tailed) = 0.000 < 0.05, so H_0 is rejected and H_1 is accepted. The average posttest score of the experimental class (70.62) is significantly higher than the control class (45.21), proving that the *Discovery Learning model assisted by Geoboard* media has a significant effect on improving students' problem-solving abilities.

Based on the results of the *N-Gain Score calculation* , the average N-Gain of the experimental class was 44.79%, which is in the medium category ($0.30 \leq$ N-Gain < 0.70), while the average N-Gain of the control class was 27.50%, which is in the low category (N-Gain < 0.30). The difference in N-Gain between the experimental class and the control class of ±17.29% indicates that the *Discovery Learning model assisted by Geoboard* media is more effective in encouraging an increase in students' problem-solving abilities

proportionally to the initial conditions of each class, compared to conventional learning.

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