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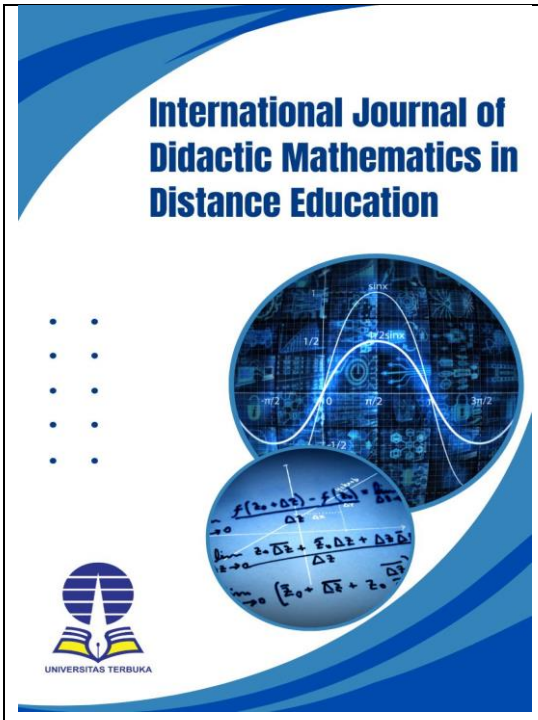

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Abstract

This study aimed to examine the difference in learning interest between students taught using the Discovery Learning model assisted by GeoGebra and those taught using conventional methods. The research employed an experimental method with a Posttest-Only Control Group Design, where the VA class acted as the experimental group and the VB class as the control group, each with 33 students. Data were collected using a learning interest questionnaire. The data was analyzed statistically by first carrying out normality and homogeneity tests on the data before carrying out the t-test. The results showed that the average learning interest score in the experimental group was in the very good category, while in the control group it was in the good category. The results of hypothesis testing with a significance level of 0.05 show that the Discovery Learning model assisted by GeoGebra has a significant effect on students' interest in learning, with this model generating higher interest compared to conventional learning methods.

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1. Introduction

Mathematics is a discipline that plays a pivotal role in developing students' logical, critical, and systematic thinking skills (Boadu et al., 2024; Tajudin & Chinnappan, 2016). At the elementary school level, mathematics education aims not only to enhance cognitive abilities but also to foster students' interest and motivation in learning (Koskinen & Pitkäniemi, 2022; Supriadi & Suherman, 2024). One of the fundamental topics taught is the area of plane figures, which serves as a crucial foundation for understanding more complex geometric concepts in higher grades (Gal & Linchevski, 2010). However, in practice, many elementary school students are not interested in mathematics lessons. This is also supported based on the results of observations carried out in several schools.

The results of observations of the learning process show that the level of student participation in mathematics learning is still low, students have difficulty understanding abstract and non-contextual mathematics learning delivered by the teacher. This understanding ultimately has an impact on students' interest in learning mathematics which is still a critical concern (Mutia et al., 2024). Therefore, innovative and interactive teaching methods are needed to attract students' interest while facilitating their understanding. This understanding ultimately impacts students' interest in learning mathematics, which remains a critical concern (Mutia et al., 2024). Therefore, innovative and interactive teaching methods are needed to engage students' interest while simultaneously facilitating their understanding.

The low level of students' interest in mathematics has become a concern for various stakeholders, as interest is one of the key factors influencing students' learning success. According to Susanti et al (2024) A monotonous, unvaried, repetitive teaching approach that lacks engaging interaction can lead to student boredom during classroom learning. Throughout the learning process, students are often limited to

listening to the teacher's explanations and taking notes on what is written on the board. In fact, active participation in the learning process can significantly influence students' understanding of the subject matter being taught. The discovery learning model is one such approach that has been proven to enhance student participation (Aisy, 2022; Amelia et al., 2024; Buton & Salamor, 2024). In addition to the application of teaching models, the use of technology-based learning media has been proven to enhance student interest. GeoGebra, as an interactive mathematics software, is one such tool that can be utilized to create a more engaging and effective learning experience. GeoGebra is a mathematics software that can be used in teaching topics such as geometry, algebra, and calculus. It serves as a visual learning medium that helps students understand abstract mathematical concepts more effectively (Simbolon, 2020).

Previous studies have demonstrated the effectiveness of GeoGebra in improving mathematics learning outcomes at various educational levels. Sagala and Sagala (2023) shows that using the GeoGebra application can increase high school students' interest in learning Mathematics in Linear Program Material. Bernard and Sunaryo (2020) also revealed that the impact of the GeoGebra application on students' learning motivation in MTs mathematics lessons on the topic of triangles is categorized as strong. The experience gained by students through the use of ICT has further motivated them to engage in learning (Sudirman et al., 2023; 2024). On the other hand, a study by Dewi et al (2020) focused on the use of GeoGebra at the high school level and found that students were motivated by the application. This was evident from the students' interest in indicators of engaging learning activities, as the lessons were presented attractively through the GeoGebra application. As a result, almost all students were stimulated to have the desire and drive to succeed in their learning. This also positively influenced students' appreciation for learning, with nearly all students showing positive responses. However, these studies primarily emphasized students' learning motivation rather than their learning interest, and focused on secondary and higher education levels.

Based on a review of 20 articles obtained through a search on Google Scholar with the keyword "utilization of GeoGebra" data was obtained for 1 article (5%) on the use of GeoGebra in elementary schools, 7 articles (35%) on the use of GeoGebra in junior high schools and as many as 12 articles (60%) use of GeoGebra in high school/vocational schools. A gap in research exists because there have been few studies specifically exploring the impact of GeoGebra on students' learning interests at the elementary school level. Furthermore, the materials typically studied are more complex mathematical topics, such as trigonometry, calculus, or advanced geometry. In reality, elementary school students require a different approach—one that is simpler, more interactive, and enjoyable to build a strong foundational understanding. This study seeks to bridge that gap by applying the discovery learning model integrated with GeoGebra to enhance elementary school students' interest in learning mathematics, specifically in the topic of the area of plane figures.

This study is important because the learning interest of elementary school students in mathematics has a long-term impact on their academic success in the future. When students develop a strong interest in mathematics from an early age, they are more likely to have a stronger motivation to learn more complex mathematical concepts at higher levels. In the context of education, interest plays a crucial role in learning. Interest serves as a motivational force that directs a person's attention toward a particular person, object, or activity. Thus, interest is an element that drives motivation, enabling individuals to concentrate on a specific object or activity (Sholehah et al., 2018). Moreover, the integration of technology in mathematics education at the elementary level aligns with the 21st-century education vision, which emphasizes the use of technology to enhance the quality of learning. The use of technology and media in the teaching and learning process not only facilitates the delivery of content but also has the potential to increase students' learning interests, motivate them, and stimulate their learning activities. This use of technology and media also positively impacts students' psychological aspects, encouraging them to become more engaged and enthusiastic in the learning process (Fathurrahman et al., 2024).

This study aims to determine the extent of the impact of the discovery learning model integrated with GeoGebra, used as an interactive learning medium, on elementary school students' interest in learning mathematics, specifically in the topic of the area of plane figures. With a more visual and interactive approach, this research is expected to contribute new insights to the development of mathematics teaching methods at the elementary level, while also offering solutions to increase students' interest in mathematics.

2. Method

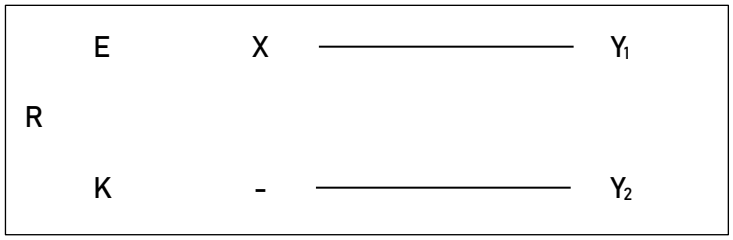
In this study, the researcher used an experimental method with a quantitative approach. The experimental method was applied to variables for which data has not yet been collected, requiring manipulation through the provision of specific treatments or interventions to the research subjects, followed by observation and measurement of the resulting impact (future data) (Priadana & Sunarsi, 2021).

2.1 Research Design

The design used in this study is the Posttest-Only Control Group Design because the effect of an intervention will be seen when the experimental class uses the discovery learning model assisted by GeoGebra. In this design, the researcher initially selected the experimental and control groups randomly. The first group received the treatment, while the second group did not. At the end of the activities, both groups were given a posttest. The research design is as Figure 1.

Figure 1

Research Design



Explanation:

R: Randomization

E: Experimental Group

K: Control Group

X: Treatment with the discovery learning model assisted by GeoGebra

Y_1: Data obtained from the experimental class after being treated with the discovery learning model assisted by GeoGebra

Y_2: Data obtained from the control class, which was not given any special treatment.

Based on the research design above, to assess the impact of the Discovery Learning model assisted by GeoGebra on students' interest in learning mathematics in the area of plane figures for fifth-grade students, the research sample was divided into control and experimental groups. The experimental group received treatment using the Discovery Learning model assisted by GeoGebra, while the control group received treatment using a different teaching model, other than the Discovery Learning model assisted by GeoGebra.

2.2 Population and Sample

Population

The population in this study consists of all fifth-grade students at SDN X in Pamekasan, East Java, for the 2024/2025 academic year. The following is the distribution data of the population in this study

Table 1

Population Distribution Table for the Study

No	Class	Students		Total
		Male	Female	
1	VA	17	16	33
2	VB	16	17	33
3	VC	12	16	28
	Total	45	49	94

Based on the data above, the population in this study consists of 94 fifth-grade students, comprising 45 male students and 49 female students.

Sampel

The sampling in this study used Simple Random Sampling (SRS). Based on the sampling technique, the next step was to determine the sample members through a random draw. The first stage involved selecting the experimental class through a lottery, and the second stage involved selecting the control class through the same method. In this study, after the lottery, Class VA was selected as the experimental class, and Class VB became the control class. Using this method, the sample consisted of 66 students. The sample used in this study is shown in Table 2 below.

Table 2

Sample Distribution Table for the Study

No	Class	Students		Total
		Male	Female	
1	VA	17	16	33
2	VB	16	17	33
	Total	33	33	66

The sample in this study consisted of 66 students, divided into two classes: Class VA with 33 students, which was the experimental group that received treatment using the Discovery Learning model assisted by GeoGebra, and Class VB with 33 students, which was the control group that received treatment using the conventional model.

2.3 Data Collection

The data collection technique in this study was through the use of questionnaires for all respondents. The questionnaire contained students' opinions regarding their learning interests after participating in the Discovery Learning model assisted by GeoGebra. The questionnaire was given to students pertained to their learning interest both after following the Discovery Learning model assisted by GeoGebra and in the control class using the conventional model. Each student selected the answer based on what they felt best reflecting their opinion or experience on the provided questionnaire. The questionnaire was adapted from the study Astuti et al. (2015). The questionnaire used by Astuti et al. (2015) had been validated and tested for reliability, so in this study, no further validity or reliability tests were conducted.

2.4 Data Analysis

In this study, students' learning interest data after the application of the Discovery Learning model assisted by GeoGebra were analyzed using correlation tests with excel. To test the hypothesis, a t-test was conducted, preceded by normality and homogeneity tests on the students' learning interest data. The analysis of the students' learning interest results used the following formula by Ningsih et al. (2023).

Table 3

Percentage Criteria for Learning Interest (Ningsih et al., 2023)

Percentage	Criteria
76%-100%	Very Good
56%-75%	Good
41%-55%	Sufficient
21%-40%	Bad
0%-20%	Very Bad

Hypothesis testing was used to determine temporary allegations formulated in the research hypothesis using a two-party test using the t-test. With the following hypothesis:

H_0 : There is no influence of the GeoGebra Assisted Learning Model on Students' Interest in Learning Mathematics

H_1 : There is an influence of the GeoGebra Assisted Learning Model on Students' Interest in Learning Mathematics

3. Results and Discussion

3.1 Results

The implementation of the Discovery Learning model assisted by GeoGebra in the Experimental Class

The intervention in the experimental class involved the implementation of the Discovery Learning model assisted by GeoGebra. The steps or stages of the Discovery Learning model used in this study are as

follows: 1) Stimulation, which involves providing stimuli to capture the students' interest in the material to be learned; 2) Problem Statement, where students are encouraged to identify the problem to be solved in the learning process; 3) Data Collection, where students gather relevant data and information related to the problem at hand; 4) Data Processing, where students analyze and organize the collected data to uncover patterns or solutions; 5) Verification, which involves analyzing and interpreting the data, also known as validation, where students verify their analysis to confirm the accuracy of their findings; 6) Generalization, where students draw conclusions based on the results obtained, formulating a broader understanding of the concept being studied (Sinambela, 2013). Here is the explanation of each stage in the Discovery Learning syntax assisted by GeoGebra for the material on the area of flat shapes, specifically triangles and parallelograms:

Stage 1: Stimulation

At this stage, the teacher provided several questions as an initial stimulus to the students, such as:

- The teacher asked about the formulas for the area of a square and a rectangle that the students had previously learned.
- The teacher asked the students to name objects that resembled a triangle and a parallelogram.

Stage 2: Problem Identification

In this stage, the teacher focused the students on the problem to be addressed, which in this case was related to the formulas for the area of a triangle and a parallelogram.

Stage 3 Data Collection

In this stage, the teacher divided the students into 8 groups, with the task details for each group as follows:

Table 4

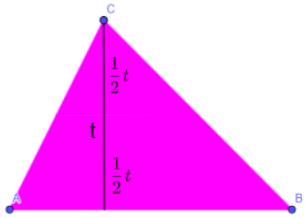
Group Division and Tasks

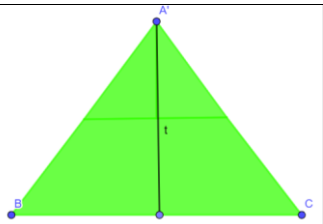
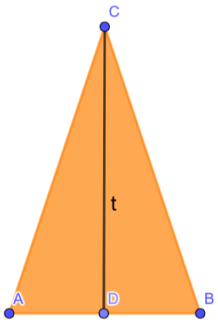
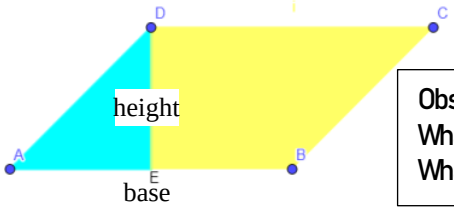
Group	Group Tasks
1	Finding the formula for the area of a general triangle
2	Finding the formula for the area of an equilateral triangle
3	Finding the formula for the area of an isosceles triangle
4	Finding the formula for the area of a scalene triangle
5	Finding the formula for the area of an equilateral triangle
6	Finding the formula for the area of an isosceles triangle
7	Finding the formula for the area of a parallelogram
8	Finding the formula for the area of a parallelogram

After the group division, the students joined their respective groups and then work on the Student Worksheet (LKPD) within each group. Each group gathered the data and information requested in the LKPD as follows:

Table 5

Group Activities in the Data Collection Phase

Group Tasks	Data Collection Activities
1 and 4	 Observe the triangle in the image! Which side is the base of the triangle? ... What is the height of triangle ABC? ...

Group Tasks		Data Collection Activities
2 and 5		Observe the triangle in the image! Which side is the base of the triangle? ... What is the height of triangle ABC? ...
3 and 6		Observe the triangle in the image! Which side is the base of the triangle? ... What is the height of triangle ABC? ...
7 and 8		Observe the parallelogram in the image! What is the base of parallelogram ABCD? What is the height of parallelogram ABCD?

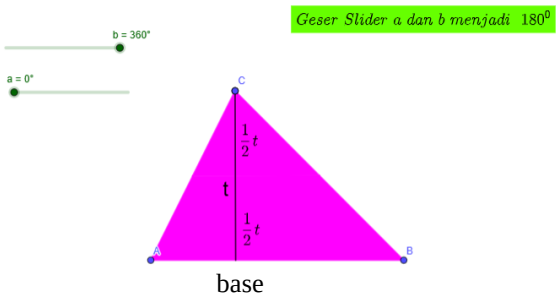
Stage 4: Data Processing

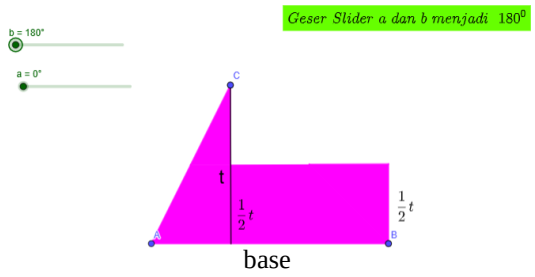
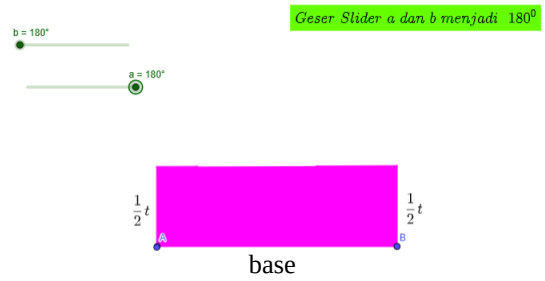
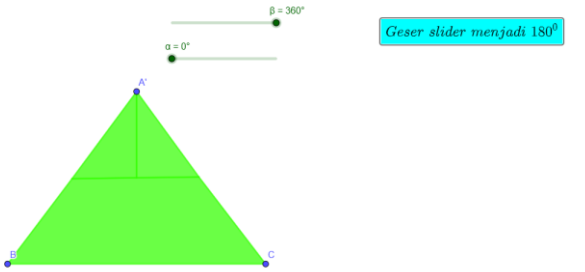
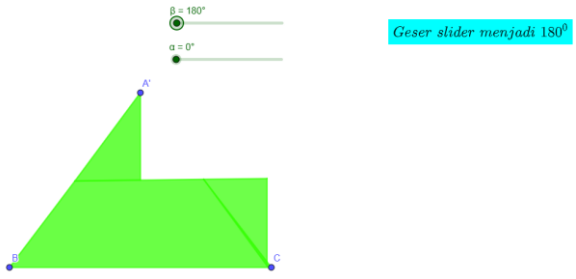
In this stage, each group performed the GeoGebra animation process according to their respective tasks, with each group being provided a Chromebook to run the GeoGebra animation for their assigned plane figures.

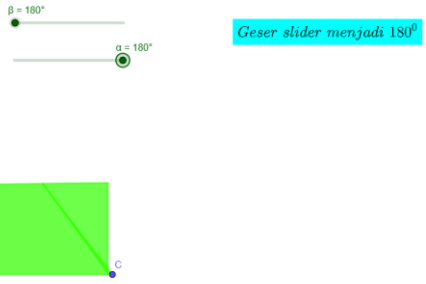
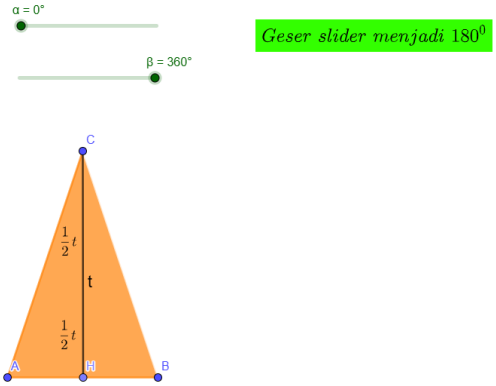
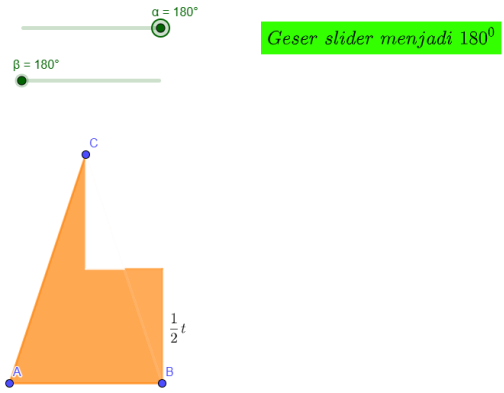
Table 6

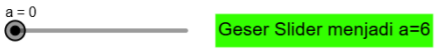
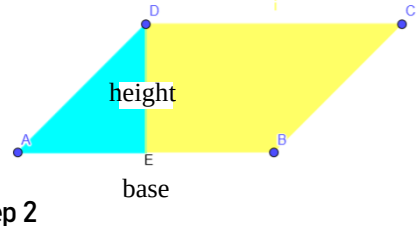
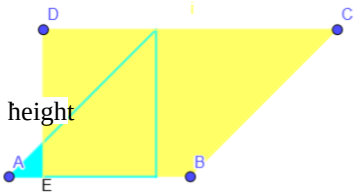
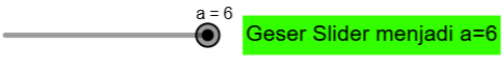
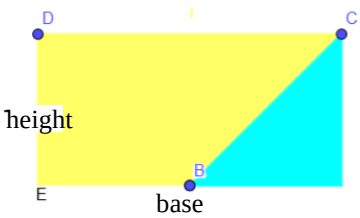
Group Activities in the Data Processing Stage

Group Tasks	Animation Activities with GeoGebra
1 and 4	Step 1



Group Tasks	Animation Activities with GeoGebra
	Step 2  Step 3  What shape is formed after you follow all the instructions provided in GeoGebra? .... The length of the shape is ... The width of the shape is ...
2 and 5	Step 1  Step 2 

Group Tasks	Animation Activities with GeoGebra
	Step 3  What shape is formed after you follow all the instructions provided in GeoGebra? .... The length of the shape is ... The width of the shape is ...
3 and 6	Step 1  Step 2 

Group Tasks	Animation Activities with GeoGebra
	Step 3   What shape is formed after you follow all the instructions provided in GeoGebra? .... The length of the shape is ... The width of the shape is ...
7 and 8	Step 1   Step 2   Step 3  

Group Tasks	Animation Activities with GeoGebra
	What shape is formed after you follow all the instructions provided in GeoGebra? .... The length of the shape is ... The width of the shape is ...

Stage 5: Proof

In this stage, students were presented with two facts: the initial plane figure and the plane figure formed through the GeoGebra-assisted animation process. Then, students were asked to draw conclusions from the activities they had completed in the LKPD.

Table 7

Group Activities in the Proof Stage

Group Tasks	Activity
1 and 4	Is the area of the scalene triangle ABC the same as the area of the new shape formed through the GeoGebra-assisted animation? The formula for the area of the new shape formed is...
2 and 5	Is the area of the equilateral triangle ABC the same as the area of the new shape formed through the GeoGebra-assisted animation? The formula for the area of the new shape formed is...
3 and 6	Is the area of the isosceles triangle ABC the same as the area of the new shape formed through the GeoGebra-assisted animation? The formula for the area of the new shape formed is...
7 and 8	Is the area of the parallelogram ABCD the same as the area of the new shape formed through the GeoGebra-assisted animation? The formula for the area of the new shape formed is...

Stage 6: Generalization

In this stage, group representatives presented their work, while groups with the same tasks served as comparators. During this stage, students, assisted by the teacher, collectively drew a conclusion from the activities carried out, which was the formula for the area of a triangle is $\frac{1}{2} \times a \times t$ and the formula for the area of a parallelogram is $a \times t$.

The Results of the Normality Test for the Discovery Learning Class Assisted by GeoGebra and the Conventional Class

The results of the normality test, both for the Discovery Learning class assisted by GeoGebra and the conventional class, using the Shapiro-Wilk test due to the sample size being below 50, are fully presented in Table 8 below.

Table 8

The Results of the Normality Test for the Discovery Learning Class Assisted by GeoGebra and the Conventional Class

No	Class	T3	T_{table}	Explanation
1	Discovery Learning Assisted by GeoGebra	0.958	0.931	Data follows a normal distribution
2	Conventional	0.976	0.931	The data is normally distributed.

Based on the normality test using the Shapiro-Wilk test assisted by MS Excel, Table 8 above shows that T3 > T_{table} = 0.931 Both in the experimental class and the control class, it can be concluded that the data in both classes follow a normal distribution

The Results of the Homogeneity Test for the Discovery Learning Class Assisted by GeoGebra and the Conventional Class

The results of the homogeneity test are fully presented in Table 9 below.

Table 9

The Results of the Normality Test

$F_{calculated}$	F_{table}	Explanation
2.37	4.15	Homogeneous Data

Based on Table 9 above, it is known that the value of $F_{calculated}$ which is 2.37, and the value of F_{table} which is 4.15, meaning the value of $F_{calculated} < F_{table}$ Therefore, it can be concluded that the data is homogeneous.

Percentage of Survey Results on Interest

Table 10

Percentage of Student Interest Survey Results in the Experimental and Control Classes

No	Statement	Percentage (%)	
		Experiment	control
1	I am interested in the mathematics material being taught	89	75
2	I feel happy every time I attend the mathematics lesson being taught	87	74
3	I enjoy the mathematics material being taught.	90	76
4	I focus my attention on the ongoing mathematics lesson.	88	80
5	I listen carefully when the teacher is explaining the mathematics material.	86	82
6	I would like to search for the material to be studied in advance.	78	75
7	I want to learn something new in mathematics.	83	72
8	I strive to solve the problems that are taught.	86	74
9	I am not interested in the mathematics material being taught.	85	75
10	I feel bored every time I attend the mathematics lesson being taught.	86	69
11	I do not like the mathematics material being taught.	85	72
12	I do not focus my attention on the ongoing mathematics lesson.	87	70
13	I do not listen carefully when the teacher is explaining the mathematics material.	88	81
14	I do not want to search for the material to be studied.	75	73
15	I do not want to learn something new in mathematics.	80	72
16	I do not make an effort to solve the problems that are taught.	82	74
	Average	85	74

Based on Table 10, the information obtained shows that in the experimental class, student interest is categorized as very strong for all statement items except for items 6 and 14. Meanwhile, in the control class, student interest is very strong only for items 5 and 13, while the others fall into the strong category. Next, to determine whether there is an effect of student learning interest after being taught using the GeoGebra-assisted discovery learning model, a hypothesis test regarding student interest.

The Results of the Hypothesis Test on Student Learning Interest Data

Table 11

The Results of the Hypothesis Test on Student Learning Interest

$T_{calculated}$	t_{table}	Description
5.237	1.693	H_1 is accepted H_0 is rejected

Based on the table above, it can be seen that the calculated t-value t_{hitung} and the table t-value at a significance level of 0,05 is 1,693. Therefore, it can be concluded that $t_{hitung} > t_{tabel}$, which means H_1 is accepted and dan H_0 is rejected. Thus, it can be concluded that there is an effect of the discovery learning strategy assisted by GeoGebra on student learning interest in the area of plane figures material in class V of SDN X in Pamekasan, East Java.

3.2 Discussion

Students in the experimental class with the discovery learning model assisted by GeoGebra participated more actively in the learning process because they were given the opportunity to discover the knowledge they want to learn through direct experimentation. This aligned with the opinion of Salamun et al (2023) In discovery learning, students were encouraged to learn primarily through their own active involvement with concepts and principles, and the teacher encouraged students to have experiences and conduct experiments that allow them to discover principles for themselves. This is in line with several research findings that show that the discovery learning model plays a role in increasing student active participation (Buton & Salamor, 2024; Mafrudah & Edy, 2023; Ningsih et al., 2023).

In the experimental class, students were guided through worksheets (LKPD) that functioned as tools to help focus or direct their thoughts in the process of discovering the formulas for the area of triangles and parallelograms, with the aid of GeoGebra animations. This approach minimized the opportunities for students to engage in off-task behavior during the learning process. In contrast, in the control class, students simply sat and listened to the teacher's explanations. As a result, students felt bored, and many talked with their classmates. This was reflected in the student survey results, where the level of boredom in the control class was higher compared to the experimental class. These findings aligned with the research by (Ningsih et al., 2023), which showed that students taught using the discovery learning model felt happier compared to those who were not taught using this model.

The application of the GeoGebra-assisted learning model can have an impact on students' learning interest. This is undoubtedly influenced by the engaging animations presented through the GeoGebra platform, which aligns with the views of Erlinawati (2018) and Yuliyawati et al. (2023) who state that GeoGebra presents interesting animations that motivate students to learn mathematics. Similarly, Kusumah (2003) argues that GeoGebra is a very suitable computer program for conveying mathematical concepts that require precision, relative concepts, and line-based solutions. Furthermore, Kusumah (2003) emphasized that the innovation of using computers for learning is highly appropriate for integrating mathematical concept teaching.

The research results indicated that the use of the GeoGebra-assisted discovery learning model affected students' learning interests. This is also reflected in the student survey results, where the learning interest in the class using the GeoGebra-assisted discovery learning model was higher compared to the control class, which did not use the model. These findings are consistent with several studies, including those by Haryuti & Hadi (2022), Ningsih et al. (2023), Sutrisno et al. (2020), and Zebua et al. (2024). However, the study by Astuti et al. (2015) shows different results, where no significant difference in learning interest was found between students taught using the discovery learning model and those who were not. A fundamental difference between this study and Astuti et al. (2015) is the use of GeoGebra, which suggests that the utilization of GeoGebra has an impact on students' learning interest. Nonetheless, further research is needed to address this issue.

4. Conclusion

Based on the research conducted and the data obtained regarding the effect of the GeoGebra-assisted Discovery Learning model on the learning interest of fifth-grade students at SDN X in Pamekasan, East Java, the following conclusions can be drawn: (1) There is an effect of the GeoGebra-assisted Discovery Learning model on students' learning interest in flat geometry material, as seen from the average learning interest score in the Discovery Learning class, which is 85%, categorized as very good. (2) There is an effect of the conventional learning model on students' learning interest in flat geometry material, as seen from the average learning interest score in the conventional class, which is 74%, categorized as good. (3) There is a significant difference in the learning interest of students taught with the GeoGebra-assisted Discovery Learning model and those taught with the conventional model, as indicated by the hypothesis testing results, where the calculated t-value (5.237) is greater than the table t-value (1.693). This means that H_1 is accepted, and H_0 is rejected so the Discovery Learning Model assisted by GeoGebra is better than conventional learning.

Limitations
This research was limited to the topic of the area of plane figures for fifth-grade students. Additionally, the population sampled was restricted to fifth-grade students at SDN X in Pamekasan, East Java.

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Author Contribution
Author 1: Conceptualization, Writing - Original Draft, Editing and Visualization;
Author 2: Methodology;
Author 3: Writing - Review & Editing
Author 4: Editing
Author 5: Teacher model in the experimental class

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Conflict of Interest
The authors declare no conflict of interest.

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