

Increasing students' interest in learning through discovery learning assisted by GeoGebra and Quizizz

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Abstract: This study aims to determine whether there is an increase in students' interest in learning mathematics through the implementation of the Discovery Learning model supported by GeoGebra and Quizizz. The research subjects were students of class VIII.4 at one of the schools in Tegal City, Indonesia. Data were collected using observation, questionnaires, and documentation. To assess students' level of interest, observations and questionnaires were administered before and after the implementation of the learning model. The pre-implementation questionnaire results showed an average interest level of 43%, with the five indicators distributed as follows: enjoyment (55%), curiosity (43%), learning activity (35%), initiative (44%), and goal-setting (38%). Post-implementation results showed an average increase to 50%, with enjoyment (61%), curiosity (47%), learning activity (49%), initiative (46%), and goal-setting (46%). These findings indicate that the use of Discovery Learning supported by GeoGebra and Quizizz can enhance students' interest in learning mathematics. This conclusion is further supported by classroom observations, which revealed that students appeared more focused and enthusiastic during the learning process.

Keywords:

Discovery Learning, Geogebra, Learning Interest, Quizizz

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1. Introduction

In mathematics education, various issues continue to hinder the achievement of effective learning outcomes, particularly related to students' interest in learning. A growing body of research indicates that many students perceive mathematics as a difficult and abstract subject, which often leads to low engagement and reduced motivation during instruction (Dewi et al., 2021; Hill et al., 2016; Jäder & Johansson, 2025; Saifiyah & Retnawati, 2019; Schoenfeld, 2022). Although numerous instructional approaches have been developed to address this issue, increasing students' interest in mathematics remains a persistent challenge.

This lack of interest is largely attributed to the perception that mathematics is a difficult and highly abstract subject, making it challenging to relate to everyday life (Ishartono et al., 2022, 2024; Nugroho et al., 2024). Furthermore, the learning process thus far has largely involved the passive transfer of knowledge rather than fostering meaningful learning experiences. As a result, it is unsurprising that students tend to forget the material, even that which was taught in the previous session. This occurs because students are passive recipients

of information, with little opportunity to construct meaning from the content presented. In addition, during individual formative assessments, students also appeared to lack enthusiasm and motivation. Therefore, efforts are needed to increase students' interest to boost their motivation and active participation in learning.

According to Kamid et al. (2022), Sarifah et al. (2022); and Setyaningrum & Waryanto (2018), a student's learning interest holds a crucial role in education. Recent research confirms that learning interest significantly affects students' engagement and academic performance. This psychological factor is strongly linked to academic performance, as students with higher learning interest tend to demonstrate greater effort and better learning outcomes (Renninger & Hidi, 2019; Wijaya et al., 2022). To be involved in any activity, an individual requires interest to carry it out effectively. Achru (2019) stated that interest is a psychological aspect within a person that can motivate them to achieve a particular goal. Therefore, when a goal is accompanied by a strong personal interest, a person will devote their attention to achieving it. Similarly, in learning mathematics—as in other subjects—if a student experiences enjoyment and interest during instruction, they can focus their attention, thereby increasing the likelihood of achieving the learning objectives (Herpratiwi & Tohir, 2022). This implies an improvement in students' academic performance. Therefore, it is necessary to have tools or media that can assist students in understanding mathematical concepts more effectively, given the abstract nature of mathematics. For example, in three-dimensional geometry, students need critical thinking skills to visualize various shapes.

An appropriate educational application for teaching three-dimensional geometry is GeoGebra. GeoGebra supports dynamic visualization, which improves students' understanding and engagement in learning mathematics (Arbain & Shukor, 2015). A meta-analysis by Zhang et al (2025) synthesizing two decades of research confirmed that GeoGebra as a dynamic visualization tool produced a positive medium-to-large effect on students' mathematics achievement, particularly in geometry topics. Consistent with Ki Hajar Dewantara's educational philosophy of *kodrat zaman*, the use of the GeoGebra application represents an educational practice that aligns with contemporary developments. Research conducted by KÜÇÜK & GÜN (2023) and Yerizon et al. (2021) demonstrated an increase in students' interest and academic achievement in spatial geometry after the implementation of GeoGebra as an educational application. Similar findings were reported by Ishartono et al. (2022), Nugroho & Septianisha (2025), and Ziatdinov & Valles (2022), who found that the use of GeoGebra in mathematics instruction elicited positive responses and enhanced students' interest in learning mathematics. In three-dimensional geometry, a common difficulty for students is visualizing and constructing geometric shapes that are typically presented in two-dimensional representations (Uwurukundo et al., 2022). Three-dimensional geometry is a subject taught across all educational levels—elementary, junior high, and senior high school—with variations in content and depth. In the Grade VIII mathematics curriculum, the focus of three-dimensional geometry lies on solid figures with flat surfaces

The prevailing curriculum in Indonesia, known as the *Merdeka* Curriculum (Independent Curriculum), provides both teachers and students with the flexibility to determine their own

learning pathways. This autonomy is intended not only to allow educators to foster greater student interest in the learning process but also to serve a broader purpose. *Merdeka Belajar* (Independent Learning) is expected to provide students with opportunities to develop their critical thinking skills. This ability has become increasingly essential in the modern era, as students are required to be responsive and perceptive to complex and competitive challenges (Nadhiroh & Anshori, 2023). Therefore, an instructional model that facilitates and cultivates students' critical thinking is needed. According to Batubara (2019), Hamidah et al. (2024), and Hernawati & Surjono (2019), the Discovery Learning model is an approach that emphasizes active student participation and the development of higher-order thinking skills. Similarly, Discovery Learning emphasizes experiential learning and the need to understand the foundational frameworks and concepts of a subject through direct participation rather than passive reception (Murni et al., 2017). Discovery learning encourages active exploration, which enhances students' motivation and conceptual understanding (Putriani & Rahayu, 2018; Subekti & Prahmana, 2021).

This process allows students to acquire new knowledge not simply by being told, but by discovering it themselves. Empirical evidence shows that discovery learning significantly improves students' motivation and participation (Suhada et al., 2024). Through self-discovery, learning becomes more meaningful and enduring, rather than superficial and easily forgotten. Critical thinking is particularly essential in mathematics education. Due to the progressive and interconnected nature of mathematical concepts, students must develop critical thinking abilities to effectively construct their own understanding and knowledge. Mathematics is a discipline that prioritizes conceptual comprehension over rote memorization.

Assessment in the *Merdeka* Curriculum is not conducted solely at the end of the learning process. There are two types of assessments administered to students: formative assessment and summative assessment. Formative assessment takes place during the learning process, while summative assessment is conducted at the conclusion of the learning period. Both serve different functions. Summative assessment aims to determine the extent of learning achievement attained, whereas formative assessment is intended to monitor students' mastery and progress of the material. To enable teachers to evaluate students' understanding, formative assessments can be given at each meeting and are usually conducted individually. However, a common issue encountered is students' lack of enthusiasm when completing these assessments, which subsequently affects learning outcomes. Research shows that gamified assessment tools can effectively address this problem by increasing student motivation and reducing assessment-related anxiety, thereby greater willingness to participate (García-López et al., 2023). One way to address this problem is by utilizing learning media that capture students' attention. The use of Quizizz as an innovative quiz platform introduces a refreshing element to the learning process and positively influences students' motivation (Dewantara, 2022; Muchuwani et al., 2025). This finding aligns with research by Setiyani et al. (2020), which demonstrated that using Quizizz increases students' interest in learning. Students appeared to enjoy the learning activities and felt more engaged when using Quizizz.

Based on the background above, students' difficulties in understanding the concepts of three-dimensional geometry from a lack of interest and engagement, insufficient focus, and the absence of appealing visual media, resulting in students feeling less enthusiastic, unmotivated, and seemingly reluctant to participate in learning. To address these issues, GeoGebra is necessary to facilitate visualization and the construction of three-dimensional shapes, while maintaining students' comprehension through the implementation of the Discovery Learning model, with Quizizz as a tool for individual assessment. Therefore, it is expected that integrating these two media will positively impact students' interest in learning mathematics.

2. Methods

This study employs a descriptive qualitative approach. The sampling technique used is saturated sampling. According to Sugiyono (2022) saturated sampling refers to a sampling technique in which the entire population is selected as the sample, as all members meet the criteria to be included in the study. Accordingly, the participants in this study comprised all 32 students in Class VIII at one of the schools in Tegal City, Indonesia, in the 2023/2024 academic year. The primary data in this study concern students' interest in learning mathematics before and after the implementation of the Discovery Learning model, which is supported by GeoGebra and Quizizz. These data were collected via a learning-interest questionnaire administered to all participants. The instrument used was adapted from a study by Armizah (2023), which identified five indicators for measuring students' interest in learning mathematics: enjoyment, interest, learning activity, learning initiative, and having learning goals. The questionnaire consisted of 10 positively framed items using a 4-point Likert scale. Data collection techniques employed in this study included observation, questionnaires, and documentation through photographs and videos. The criteria used to evaluate students' learning interest were based on the indicators developed by Lestari (2022) (see Table 1).

Table 1. Percentage Criteria for Students' Interest Based on Questionnaire Responses

Interest Criteria	Category
$P = 0\%$	None
$0\% < P < 25\%$	A few
$25\% \leq P \leq 50\%$	Nearly half
$P = 50\%$	Half
$50\% < P < 75\%$	Majority
$75\% \leq P \leq 100\%$	Almost all
$P = 100\%$	All

In this study, the data analysis technique employed was to calculate the average percentage of student responses for each item, indicator, and overall. To determine the

magnitude of the average percentage, the formula proposed by Arikunto (2013) was applied as follows:

$$P_m = \frac{\sum f_i P_i}{n} \times 100\%$$

Where:

P_m = the average percentage of student responses for the i -th item

f_i = the frequency of selected responses for the i -th item

P_i = the percentage of selected responses for the i -th item

n = the total number of items

To calculate the overall average percentage of student responses across indicators or the entire assessment, the following formula was used:

$$P_T = \frac{\sum P_m}{k} \times 100\%$$

Where:

P_T = the overall average percentage of student responses across indicators or total items

P_m = the average percentage of student responses for each item

n = the total number of items or indicators

3. Results and Discussion

3.1 Description of Learning Implementation

The success of a learning process is not solely dependent on the teacher and students. Rather, it is influenced by a variety of supporting aspects. These include the appropriate selection of instructional models and methods, as well as the use of effective learning media. When these elements are integrated, they are expected to create meaningful learning experiences, as reflected in students' heightened interest and enthusiasm during the learning process. This study exemplifies such an approach. Triggered by the results of a diagnostic assessment indicating students' low ability to recognize the elements of three-dimensional shapes, this research was conducted to address that issue.

Today, integrating learning media into classroom instruction is no longer a challenge. Even the simplest media can have a significant impact when implemented in accordance with students' conditions and the nature of the subject matter. In the instructional activities conducted, the use of learning media such as GeoGebra and Quizizz exemplifies an effective application of technology in education. Globalization has brought numerous changes, one of which is in education, particularly through technological integration. The suitability of these media lies in their alignment with students' needs and the characteristics of the subject matter—specifically, three-dimensional shapes. Please refer to the following image.



Figure 1. The teacher provides instructions on how to use GeoGebra

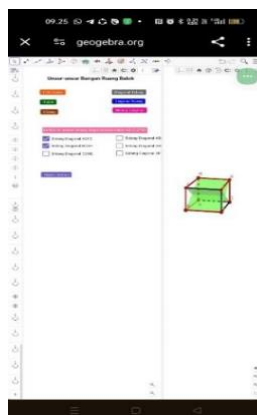


Figure 2. The display of GeoGebra on a smartphone

Figure 1 shows the teacher explaining the use of the GeoGebra application. This was necessary because students were newly introduced to the learning media and were beginning to apply it. As a result, it sparked their enthusiasm to engage with the application during the lesson. Meanwhile, Figure 2 displays the GeoGebra interface on a student's mobile phone. It can be observed that the application's technical operation involves checking boxes on the left side of the interface to display the elements of a rectangular prism. When selected, these checkboxes immediately reveal the corresponding elements on the geometric figure. Based on classroom observations, the use of GeoGebra created a fresh and engaging learning atmosphere. This medium was a new experience for students, contributing to their increased focus and enthusiasm for using it. Through this learning media, students were encouraged to independently explore and collaborate with peers to identify and demonstrate the elements of a rectangular prism. State that applying the Discovery Learning model is effective for enhancing students' understanding and potential. The model leaves a strong impression, enabling students to more easily retain the information they acquire.

Although learning with GeoGebra media left a positive impression, several challenges were encountered. One of the main issues was that some students' mobile phones were not compatible with the application. This was due to the devices having limited memory capacity, as they were already loaded with various applications. As a result, GeoGebra's performance was affected, causing the application to run slowly. This situation was disruptive during the learning process. Although the teacher had previously checked the devices and confirmed their usability, the variation in students' mobile phone specifications made this issue unavoidable. Meanwhile, the use of Quizizz during assessment received a positive response from the students. They willingly participated in the assessment without any coercion. This addressed a recurring issue in which students were typically reluctant to engage with

assessments. Based on classroom observations, students appeared highly enthusiastic when asked to complete a Quizizz activity. They were curious to see the scores they obtained upon completion, which significantly increased their motivation. This was in stark contrast to conventional assessments, which were often perceived as tedious and unengaging. The following figure illustrates students working on the Quizizz assessment.



Figure 3. Students are working on an assessment using Quizizz

3.2 Improvement in Students' Learning Interest Toward the Implemented Learning Activities

To determine whether there was an increase in students' interest in learning mathematics after the implementation of the Discovery Learning model, supported by GeoGebra and Quizizz, a questionnaire was administered to students before and after the learning process. The results of the pre-learning questionnaire, completed by 31 respondents, are shown in Table 3.

Based on Table 2, the first indicator, namely positive emotional response, achieved an average percentage of 55%, indicating that most students felt happy while participating in mathematics learning. The second indicator, student interest, had an average percentage of 43%, suggesting that nearly half of the students were interested in learning mathematics. The third indicator, student participation in learning activities, showed an average of 35%, indicating that approximately half of the students participated in mathematics learning activities. For the fourth indicator, having learning goals, the average percentage was 44%, implying that nearly half of the students had academic targets during mathematics lessons. The fifth indicator, learning initiative, reached an average percentage of 38%, indicating that about half of the students demonstrated initiative in mathematics learning. Overall, the percentage of students interested in learning mathematics prior to the implementation of the instructional model was 43%, indicating that nearly half of the students were interested in learning mathematics. Moreover, the data in Table 3 show that the average percentages for all indicators of learning interest remain within the low category. Among the five indicators, the highest percentage was found in positive emotional response, while the lowest was observed in student participation in learning activities.

Table 2. Percentage of Student Learning Interest Indicators After Learning Implementation

No.	Indicator	Average Percentage	Interpretation
1. Emotional Response			
a.	I understand the teacher's explanations during mathematics instruction.	55%	Most of them
b.	I always feel happy and enthusiastic during mathematics lessons		
2. Attention to the Material			
a.	When the teacher explains mathematical concepts, I feel motivated to try understanding them independently.	43%	Nearly half
b.	After a mathematics lesson, I tend to ask questions about the material that was taught.		
3. Learning Activity			
a.	I always ask the teacher questions when I do not understand the material.	35%	Nearly half
b.	After studying mathematics, I am able to solve problems effectively		
4. Achieving Learning Goals			
a.	I always make a strong effort to achieve optimal academic outcomes.	44%	Nearly half
b.	I consistently seek alternative strategies when I make mistakes in problem-solving		
5. Willingness to Learn			
a.	I study based on my own willingness and motivation	38%	Nearly half
b.	I regularly share my opinions during group learning activities.		
Total Percentage of Students' Learning Interest		43%	Nearly half

Meanwhile, after implementing the Discovery Learning model using GeoGebra and Quizizz, the following results were obtained, as shown in Table 3. Based on Table 3, the first indicator, namely positive emotional response, achieved an average percentage of 61%, indicating that most students felt happy while participating in mathematics learning. The second indicator, student interest, obtained an average percentage of 47%, suggesting that nearly half of the students were interested in learning mathematics using GeoGebra and Quizizz. The third indicator, student learning engagement, showed an average percentage of 49%, indicating that approximately half of the students were actively engaged in learning mathematics. For the fourth indicator, having learning goals, the average percentage was 46%, implying that nearly half of the students had set academic goals during mathematics instruction. The fifth indicator, learning initiative, also reached an average percentage of 46%, indicating that about half of the students demonstrated initiative in their mathematics learning. Overall, the percentage of students' interest in learning mathematics prior to the implementation of the instructional model was 50%, indicating that half of the students already showed interest in learning mathematics.

Table 3. Percentage of Student Learning Interest Indicators After Learning Implementation

No.	Indicator	Average Percentage	Interpretation
1. Emotional Response			
a.	Learning mathematics using GeoGebra and Quizizz helps me understand the material better.	61%	Most of them
b.	I always feel happy and enthusiastic during the lesson.		
2. Attention to the Material			
a.	When the teacher presents material using GeoGebra and Quizizz, I focus more on the lesson.	47%	Nearly half
b.	GeoGebra and Quizizz help me to better understand the material presented.		
3. Learning Activity			
a.	I actively ask questions when I don't understand.	49%	Nearly half
b.	Learning mathematics using GeoGebra and Quizizz motivates me to be more active in class.		
4. Achieving Learning Goals			
a.	I study more seriously so I can achieve my best learning outcomes.	46%	Nearly half
b.	I try to complete the given tasks optimally.		
5. Willingness to Learn			
a.	I am interested in learning mathematics.	46%	Nearly half
b.	I am always enthusiastic when assigned mathematics learning tasks.		
Total Percentage of Students' Learning Interest		50%	Nearly half

By comparing the percentages of students' learning interest, it was found that there was an overall increase in students' interest in learning mathematics from before to after the instructional intervention. The overall percentage of learning interest before instruction was 43%, increasing to 50% after instruction. This indicates that after the learning process, half of the students demonstrated an interest in mathematics. For each indicator, the positive emotional response averaged 55% before instruction and increased to 61% after instruction. For the student interest indicator, the average percentage rose from 43% before instruction to 47% after instruction. The student participation indicator increased from 35% before instruction to 49% after instruction. The learning goals indicator increased from 44% prior to instruction to 46% after instruction. Finally, the learning initiative indicator improved from 38% before instruction to 46% following the instructional period.

Based on the above description, overall, each indicator showed an increase in percentage, although the increase was not statistically significant. This indicates that the improvement in students' interest in learning mathematics occurred not only in the overall total percentage but also in each individual indicator. This means that the Discovery Learning model, implemented with the assistance of GeoGebra and Quizizz, enhanced students' interest in learning. These findings are consistent with the study by Hanipa et al. (2022), which

demonstrated an increase in students' learning. Similar findings have been reported in recent studies, which show that discovery learning leads to higher motivation than traditional learning models (Sahari & Ayunis, 2024). The introduction of new experiences during the learning process using GeoGebra media stimulated students' curiosity and encouraged active participation in learning. Furthermore, Ameliana, Rosyana, and Purwasih (2019) found that the use of the GeoGebra application effectively engaged students in learning and fostered their confidence to actively participate in the learning process. Meanwhile, in the study by Azhari, Adhimah, and Huda (2023), the implementation of quizzes using Quizizz was found to increase students' interest in learning mathematics during instruction.

4. Conclusion

Based on the description of the learning implementation and the analysis of students' interest in learning mathematics, it can be concluded that the application of the Discovery Learning model assisted by GeoGebra and Quizizz was effective in helping teachers increase students' interest in learning mathematics, particularly on the topic of three-dimensional shapes (cuboids). The use of GeoGebra supported teachers in providing students with concrete conceptual understanding, while Quizizz served as an innovative assessment tool that successfully motivated students to engage in learning tasks. As a suggestion for future research, those interested in exploring the use of GeoGebra and Quizizz are encouraged to further develop their application across a wider range of mathematical topics or within different instructional models, while addressing any challenges encountered and introducing new, innovative improvements.

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