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The Effect of Flipbook-Assisted Discovery Learning on Student Learning Achievement

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Keywords

discovery learning, digital flipbook, mathematics learning achievements, flat quadrilateral shapes, technology-based learning

Abstract

Low mathematics learning achievement and minimal use of learning media are problems in mathematics learning, especially in the subject of quadrilateral shapes. This study aims to determine the effect of the discovery learning model assisted by flipbooks on the mathematics learning achievement of seventh-grade students at SMP Negeri 1 Rengel. This study used a quasi-experimental method with a non-equivalent control group design. The research subjects consisted of class VII C as the experimental class and class VII A as the control class. Data were collected through learning achievement tests and analysed using the t-test. The results showed that the learning achievement of students who participated in discovery learning assisted by flipbooks was higher than that of students who participated in conventional learning. Thus, the discovery learning model assisted by flipbooks had a positive effect on students' mathematics learning achievement.

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Introduction

Education is a strategic vehicle in shaping and developing an individual's personality to achieve meaningful life goals (Gulo & Mendrofa, 2024). In the context of national development, education plays a crucial role as it is the main means of improving the quality of competitive human resources (Sadriani et al., 2023). Through education, individuals acquire knowledge, skills, and insights that can encourage improved quality of life and contribute to society (Warisno, 2021). Therefore, education not only functions as a process of knowledge transfer, but also as a foundation for shaping a competent and characterful future generation (Rahmawati & Nurachadija, 2023). This educational process is realised through learning activities that are systematically designed to develop students' cognitive, affective, and psychomotor abilities, one of which is through mathematics learning.

Mathematics is an essential subject taught at every level of formal education (Ahmad et al., 2024). This is due to the characteristics of mathematics, which emphasise the use of logic, reasoning, patterns, structures, quantities, and relationships between concepts (Robbany Arham, 2022). Mastery of mathematics is important because it plays a role in training students' logical, analytical, and systematic thinking skills, which are needed to solve various problems (Farhan & Jumardi, 2023). In addition, mathematics is applicable because its concepts are widely used in everyday life and form the basis for various other disciplines, such as science, technology, and economics (Lestari et al., 2025). Therefore, mathematics learning has a strategic position in equipping students with relevant higher-order thinking skills throughout their lives.

Despite its very important role, mathematics learning is still often perceived negatively by students. Most students consider mathematics to be a difficult and intimidating subject (Hidayah et al., 2022). This negative perception has an impact on students' low motivation to learn and their achievements. This condition is reflected in the results of the 2022 Programme for International Student Assessment (PISA) released by the Organisation for Economic Co-operation and Development (OECD), in which Indonesia ranked 6th out of 8 ASEAN countries with a mathematics score of 366. Globally, Indonesia ranked 70th out of 81 PISA participating countries. This data shows that Indonesian students' mathematical literacy skills are still relatively low and require serious attention.

The low achievement in mathematics is also reinforced by empirical findings in the field. Based on interviews with mathematics teachers in Grade VII at SMP Negeri 1 Rengel, it was found that many students still scored below the Minimum Passing Grade (KKM) of 75. One of the contributing factors is the difficulty students have in solving mathematics problems, especially those involving quadrilateral shapes. In addition, the learning process tends to be dominated by a conventional teacher-centred learning model, which makes students passive. The suboptimal use of learning media and the lack of connection between the material and everyday life further exacerbate the learning conditions. This situation emphasises the need for learning innovations that can increase student activity and learning achievement.

One alternative learning innovation that can be applied is the use of an interactive, student-centred learning model that encourages active engagement in the learning process.

The discovery learning model is one model that meets these characteristics. Bruner states that discovery learning is a learning approach that encourages students to discover concepts independently through a process of exploration and problem solving (Khoiriyah & Murniyati, 2021). Purnamadewi and Wiyasa (2022) emphasise that discovery learning is able to actively involve students in the process of identifying concepts and improving critical thinking skills. In addition, Usaha et al. (2022) stated that this model encourages students to draw conclusions based on their observations and learning experiences. Thus, it can be synthesised that discovery learning has the potential to improve student learning achievement by strengthening their activity, independence, and higher-order thinking skills.

In its implementation, the effectiveness of the discovery learning model can be optimised through the use of learning technology. One relevant technology-based medium is the flipbook. A flipbook is a digital book innovation that presents pages similar to printed books with animation effects (Talitha et al., 2023). This medium can be accessed through various electronic devices such as computers, laptops, tablets, and smartphones (Wibowo et al., 2025). In addition, flipbooks are equipped with interactive features in the form of text, images, audio, and video that can create a more interesting and contextual learning atmosphere (Juliana et al., 2025). These characteristics make flipbooks a potential medium to support abstract mathematics learning.

Various studies show that the use of flipbooks has a positive impact on the learning process and outcomes of students, such as improving learning experiences (Putra et al., 2023), learning motivation (Awwaliyaha et al., 2021), and student engagement in learning (Prananda et al., 2025). Nudin's (2024) research shows that the use of flipbooks in informatics learning can improve student learning achievement from 72% in cycle I to 84.84% in cycle II. Furthermore, Anggraeni et al. (2023) found that the application of discovery learning assisted by flipbooks in social studies learning increased student learning outcomes by 79.4%. However, these studies have not specifically examined the application of discovery learning assisted by flipbooks in mathematics learning, particularly in the subject of quadrilateral shapes. Therefore, this study has elements of novelty and urgency.

The steps of discovery learning assisted by flipbooks in this study include: (1) the preparation stage, in which the researcher prepares e-module flipbooks and students prepare electronic devices; (2) the introduction stage, in which students are introduced to flipbooks and how to use them; (3) the exploration stage, in which the teacher acts as a facilitator and students search for and find information from flipbooks; (4) the observation stage, in which students record the information obtained; (5) the discussion stage, in which students discuss in small groups; and (6) the evaluation stage, in which students complete questions based on the results of their observations and discussions.

The material used in this study is quadrilateral shapes, which are two-dimensional shapes with four straight sides as their boundaries (Haliza & Syabrina, 2023). This material includes squares, rectangles, parallelograms, trapezoids, kites, and rhombuses. Mastery of quadrilateral flat shapes is important because it forms the basis for developing students' visualisation, geometric reasoning, and mathematical problem-solving skills.

Based on this background, this study aims to analyse the effect of the discovery learning model assisted by flipbooks on the mathematics learning achievement of Year 7 students in the subject of quadrilateral flat shapes. The results of this study are expected to contribute theoretically and practically to the development of effective, student-centred, technology-based mathematics learning innovations.

Method

Research design

This study used a quantitative approach with a quasi-experimental method. This method was chosen because the researcher was unable to fully randomise the subjects, so existing classes were used (Sugiyono, 2022). The research design used was a non-equivalent control group design, which involved two groups, namely the experimental group and the control group.

The experimental group and the control group were each given a pre-test and a post-test. The experimental group received treatment in the form of the application of the flipbook-assisted discovery learning model, while the control group received conventional learning using the lecture method. Schematically, the research design can be described as follows:

Experimental group (VII C): $O_1 - X - O_2$

Control group (VII A): $O_1 - - O_2$

Explanation:

O_1 = pre-test

O_2 = post-test

X = treatment using the flipbook-assisted discovery learning model

This design allows researchers to compare student learning achievement between groups after the treatment is given (Creswell & Creswell, 2018).

Research sample

This study was conducted at SMP Negeri 1 Rengel in the 2024/2025 academic year. The research subjects were seventh-grade students, with a sample of two classes, namely class VII C as the experimental class and class VII A as the control class. The determination of the experimental and control classes was based on the results of initial observations and data from the odd semester final exams (UAS) for the 2024/2025 academic year. The results of the analysis showed that both classes had normal, homogeneous, and balanced initial conditions, making them suitable as research samples. The variables involved in this study consisted of: (1.) Independent variable, namely the discovery learning model assisted by flipbooks, (2.) Dependent variable, namely students' mathematics learning achievement in rectangular plane figures. The instrument used in this study was a mathematics achievement test. The test was compiled based on indicators of competence in quadrilateral shapes, which included types of

quadrilaterals, properties of quadrilaterals, and formulas for the perimeter and area of quadrilateral shapes. The test instrument consisted of five essay questions. Before use, the instrument was tested for validity, reliability, level of difficulty, and discriminating power, so that it was suitable for measuring student learning achievement ([Arikunto, 2019](#)).

Research procedure

The research procedure was carried out in three main stages, namely:

1. Preparation Stage

In this stage, the researcher conducted initial observations of the mathematics learning process in Grade VII. Based on the observation results, it was found that students were less enthusiastic about learning, teachers rarely used learning media, and there were still students who scored below the minimum passing grade and had difficulties with quadrilateral shapes, particularly in distinguishing and using the formulas for the area of a kite and a rhombus.

Next, the researcher compiled learning tools and developed a flipbook in the form of an e-module. The e-module contained learning objectives, material on quadrilateral shapes, definitions and properties of quadrilaterals, formulas for perimeter and area, example questions, and contextual exercises.

2. Implementation Stage

During the implementation stage, Class VII C, as the experimental class, was taught using the discovery learning model assisted by flipbooks. The teacher and researcher acted as facilitators who guided students in discovering concepts through exploring the information contained in the flipbooks. Students recorded their findings, discussed them in groups, collected data, and independently developed problem-solving concepts. The learning process was active and interactive, with students directly involved in problem solving. This was in line with the opinion of [Cahyana and Putra \(2022\)](#), who stated that discovery learning trains students to discover and solve problems independently.

Meanwhile, class VII A, as the control class, received conventional learning using the lecture method. The teacher conveyed the learning objectives, material, and sample questions, then the students worked on the exercises. The learning process was one-way, and students tended to be passive.

3. Final Stage

After the learning process was completed, both classes were given a final test (post-test) to measure student learning achievement. The test results were then collected for statistical analysis.

Data analysis

The data obtained were analysed using inferential statistics. The analysis began with prerequisite tests, namely normality and homogeneity tests. The normality test was conducted

to determine whether the data were normally distributed, while the homogeneity test aimed to determine the similarity of variances between groups (Ghozali, 2021).

After the data met the prerequisites, hypothesis testing was performed using the independent samples t-test. The results of the analysis showed that the t-count value was greater than the t-table value, so the null hypothesis was rejected. Thus, there was a difference in mathematics learning achievement between students who learned using discovery learning assisted by flipbooks and students who learned using conventional learning.

Results and Discussion

Results

This study was conducted at SMP Negeri 1 Rengel involving two classes, namely class VII C as the experimental class and class VII A as the control class. Based on initial observations, several problems were found in mathematics learning, including low student enthusiasm, limited and conventional use of learning media, and the existence of students who scored below the Minimum Passing Grade (KKM). In addition, students had difficulty with quadrilateral shapes, particularly in distinguishing and using the formulas for the area of a kite and a rhombus.

The analysis of the odd semester final exam (UAS) scores for the 2024/2025 academic year showed that classes VII A and VII C had normal, homogeneous, and balanced initial conditions, making them suitable as research samples.

As a follow-up to these findings, class VII C was given treatment in the form of the application of the discovery learning model assisted by flipbooks, while class VII A received conventional learning. During the preparation stage, the researcher developed a flipbook in the form of an e-module containing learning objectives, material on quadrilateral shapes, definitions and properties of quadrilaterals, formulas for perimeter and area, example questions, and contextual practice questions.



Figure 1. Discovery Learning-Assisted Flipbook Display

During the implementation stage, students in the experimental class were introduced to the flipbook and how to use it. Teachers and researchers acted as facilitators, while students actively explored the information contained in the flipbook, recorded their findings, and

discussed them in groups. The learning process was interactive and encouraged students to actively engage in discovering concepts and solving mathematical problems. In contrast, in class VII A, which served as the control class, learning was conducted using the lecture method. The teacher conveyed the learning objectives, material, and sample questions, and then the students worked on the exercises. The learning process was one-way, and students tended to be passive and rarely asked questions.

After the learning process was completed, both classes were given a final test (post-test) consisting of five essay questions that had been tested for validity, reliability, level of difficulty, and discriminating power. The results of the descriptive analysis of student learning achievement are presented in Table 1.

Table 1. Description of Student Learning Achievement Data

Class	Data Statistics				
	Modus	\bar{X}	S	X_{maks}	X_{min}
VII C	84	80,143	11,302	100	60
VII A	68	72,925	9,786	100	55

Based on Table 1, it can be seen that the average learning achievement score of the experimental class was higher than that of the control class. This indicates a difference in learning achievement between the two classes after the treatment was given. Before testing the hypothesis, the data was first tested for analysis prerequisites. The results of the normality test are presented in Table 2.

Table 2. Normality Test Results

Class	$L_{calculated}$	$L_{tabulated}$	Test Decision	Description
VII C (Experiment)	0,081	0,137	H_0 accepted	Berdistribusi normal
VII A (Control)	0,113	0,140	H_0 accepted	Berdistribusi normal

The homogeneity test results show that the Fcount value is less than the Ftable value ($0.750 < 1.696$), indicating that the two classes have homogeneous variances. With the prerequisites of normality and homogeneity fulfilled, hypothesis testing was conducted using an independent two-sample t-test. The t-test results show that the t-calculated value = 3.085 is greater than the t-table value = 1.990, so H_0 is rejected. Thus, there is a significant difference between the mathematics learning achievements of students in the experimental class and the control class. The higher average score of class VII C shows that flipbook-assisted discovery learning has a positive effect on student learning achievements.

Discussion

The results of the study indicate that the application of the discovery learning model assisted by flipbooks can significantly improve students' mathematics learning achievement compared to conventional learning. This improvement is inseparable from the active involvement of students in the learning process, where students are encouraged to discover

concepts through exploration, discussion, and independent problem solving. In the experimental class, the use of flipbooks as a learning medium helped students visualise the concept of quadrilateral shapes, which had previously been difficult to understand. The visual features and systematic presentation of material in the flipbook made it easier for students to distinguish the characteristics and area formulas of flat shapes, especially between kites and rhombuses. This shows that interactive digital media can improve students' conceptual understanding in mathematics learning (Putra et al., 2023).

In addition, the learning atmosphere in the experimental class felt more enjoyable and less boring. Learning took place in a two-way manner, with students actively discussing and expressing ideas, while the teacher acted as a facilitator. This condition is in line with the findings of Cahyana and Putra (2022), who stated that discovery learning trains students in problem finding and problem solving, thereby encouraging independent learning. Conversely, conventional learning applied in the control class tends to make students passive because the learning process is dominated by the teacher. The minimal use of learning media causes students to lose interest and results in low learning achievement. These findings reinforce the view that teacher-centred learning is less effective in improving mathematics learning outcomes.

The results of this study are consistent with the research by Gulo and Mendrofa (2024), which concluded that flipbook-based e-modules using discovery learning are effective in improving student learning outcomes. In addition, Mahardinata et al. (2024) also stated that learning that emphasises concept discovery and quality material presentation can create meaningful learning and improve student learning outcomes. Overall, the results and discussion of this study indicate that the discovery learning model assisted by flipbooks not only has an impact on improving students' mathematics learning achievement but is also capable of improving the quality of the learning process through active involvement, a pleasant learning atmosphere, and a deeper conceptual understanding.

Conclusion

Based on the results of the research and discussion, it can be concluded that the discovery learning model assisted by flipbooks has a significant effect on the mathematics learning achievements of Grade VII students at SMP Negeri 1 Rengel in the subject of quadrilateral shapes. This is evidenced by the difference in the average learning achievement scores between the experimental class and the control class, where the experimental class obtained a higher average score (80.143) than the control class (72.925). In addition, the t-test results show that the t-count is greater than the t-table, so the null hypothesis is rejected and the alternative hypothesis is accepted. The application of discovery learning assisted by flipbooks was able to increase student activity in the learning process, help students understand abstract geometric concepts, and overcome students' difficulties in distinguishing and using the formulas for the area of quadrilaterals, especially kites and rhombuses. The student-centred learning process, supported by interactive digital media, creates a more enjoyable and meaningful learning atmosphere, thereby having a positive impact on students'

learning achievements. Meanwhile, the implications of this research have several important implications, both theoretically and practically, including:

Theoretically, this research reinforces the constructivist theory which states that knowledge is actively constructed by students through the process of discovery and direct learning experiences. These findings also enrich empirical studies on the effectiveness of integrating the discovery learning model with flipbook-based digital media in mathematics learning, particularly in the subject of quadrilateral shapes. In practical terms, the results of this study imply that mathematics teachers should be more innovative in designing learning by combining student-centred learning models and the use of learning technology. The use of flipbooks as a learning medium can be an alternative to increase students' interest, engagement, and learning achievement. In addition, schools are expected to support the development and use of digital learning media as part of efforts to improve the quality of learning. For future researchers, the results of this study can be used as a reference for developing similar studies with broader material coverage, different education levels, or by adding other variables such as learning motivation, critical thinking skills, and mathematical literacy. Further research is also recommended to examine the effectiveness of the flipbook-assisted discovery learning model over a longer period of time to see its sustainable impact.

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