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Application of Interactive Digital Book-Assisted Discovery Learning to Improve Mathematics Learning Outcomes of Grade IV Elementary School Students

Dyah Triwahyuningtyas [1*], Siti Nuryatus Sofiya [1], Yuyun Setyaningsih [2]
[1] Universitas PGRI Kanjuruhan Malang, Indonesia
[2] Sekolah Dasar Negeri 1 Bakalan Krajan Malang, Indonesia
* Author Correspondence

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Abstract
This study aims to improve students' mathematics learning outcomes through the application of the Discovery Learning model assisted by interactive digital books on the topic of flat shapes. The research was motivated by the low achievement of learning completeness among grade IV students at Bakalan Krajan 1 Public Elementary School, Malang, primarily due to conventional teaching methods that lacked student engagement. The study involved 28 fourth-grade students and employed a Classroom Action Research (CAR) method using the Kemmis and McTaggart spiral design, conducted over two cycles. Each cycle included the stages of planning, action implementation, observation, and reflection. Data were collected through learning outcome tests administered at each meeting, and analyzed quantitatively using descriptive statistics to determine the percentage of learning completeness. The results indicated a steady improvement in learning outcomes, with completeness increasing from 53.5% in the first meeting of Cycle I to 60.7% in the second meeting. In Cycle II, the percentage rose significantly to 78.5% in the first meeting and reached 85.7% by the second. These findings demonstrate that the Discovery Learning model, supported by interactive digital books, effectively enhances students' mathematics learning outcomes by promoting active participation in the learning process. However, the study's limitations include a relatively short implementation period and a small sample limited to one class.

Contact : Corresponding author e-mail: dyahtriwahyuningtyas@unikama.ac.id

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Introduction

Basic education has a strategic role in building 21st century competencies, especially in the aspects of literacy, numeracy, and mastery of information technology. One of the fields of study that is an important foundation in the development of students' logical and analytical thinking skills is mathematics. Numeracy literacy is one of the main indicators in determining the readiness of the younger generation to face the era of globalization and competition in the increasingly data- and technology-based world of work. Based on the 2019 Trends in International Mathematics and Science Study (TIMSS) report, Indonesia ranks 45th out of 58 countries in the achievement of mathematics competencies of grade IV elementary school students (Mullis et al., 2020). This condition shows that there are still major challenges in improving the quality of mathematics learning in Indonesia in order to be able to compete at the global level.

Nationally, the low numeracy literacy of Indonesian students is also identified through the results of the Minimum Competency Assessment organized by the Ministry of Education and Culture in 2022. Based on a report by the Center for Education Assessment (2022), as many as 51% of elementary school students are in the category below competent in numeracy literacy. In addition, the Programme for International Student Assessment (PISA) study in 2018 also noted that Indonesian students' mathematics scores were ranked 73rd out of 79 participating countries (OECD, 2019). This condition is exacerbated by students' perception of mathematics subjects which are often considered difficult, boring, and unpleasant (Siregar & Restati, 2017). Therefore, serious efforts are needed from various parties, especially teachers, to design mathematics learning that is more contextual, active, and interesting.

Similar problems were also found at Bakalan Krajan 1 Public Elementary School, Malang. Based on the results of initial observations made by researchers in the odd semester of the 2024/2025 school year in grade IV, data was obtained that most students had difficulty understanding flat building materials. This is reflected in the results of the pre-cycle evaluation, where only 10 out of 28 students or 35.7% achieved learning completion. Meanwhile, the other 64.3% of students are still below the Minimum Completeness Criteria set by the school. In addition, students' complaints about mathematics learning that are considered monotonous and uninteresting are also often conveyed to classroom teachers. This condition confirms that it is necessary to innovate in the mathematics learning process in the classroom.

The analysis of the causes of the problem shows that the low mathematics learning outcomes of students in grade IV of Bakalan Krajan 1 Public Elementary School, Malangare caused by learning that tends to be one-way with conventional lecture methods. Teachers are more dominant in delivering material without actively involving students in the learning process. This is in line with the findings of Fadilah et al. (2023) who stated that the lecture method has weaknesses, including difficulty in knowing the level of understanding of students, only effective for auditory learners, and boring if the teacher is less communicative. In addition, the characteristics of elementary school-age children who require concrete, exploratory, and interactive visual media activities are not met in the learning model that has been applied so far.

As a solution, one of the learning models that suits the characteristics of elementary school-age children is Discovery Learning. This model encourages students to actively discover

concepts through simple observation, exploration, and experimentation. According to Khasinah (2021), Discovery Learning has six learning syntax, namely stimulation, problem statement, data collection, data processing, verification, and generalization. The application of this stage is considered effective in developing students' curiosity, problem-solving skills, and critical thinking skills (Umayah, 2019). In mathematics learning, Discovery Learning allows students to understand the concept of flat building through the process of exploring examples of shapes around them before coming to a conclusion.

In addition to learning models, interesting media also play an important role in improving the quality of mathematics learning. One of the media that can be used is an interactive e-book. This media presents learning materials visually through text, images, animations, videos, educational games, and digital LKPD that can be accessed at any time. According to Hanikah et al. (2022), interactive e-books are effective in increasing learning motivation and making it easier for students to understand the material. Another study by Solikah & Susantini (2022) also shows that interactive e-books are able to accommodate a variety of learners' learning styles, both visual, auditory, and kinesthetic. With this media, the mathematics learning process becomes more fun, interactive, and meaningful.

However, based on a literature review, there are still few studies that directly examine the integration of the Discovery Learning model with interactive e-book media in mathematics learning in elementary schools. Most of the research only focuses on the application of Discovery Learning only, or the use of interactive e-books as a medium to support learning. Therefore, this research is unique by combining the two approaches in one learning design to improve the mathematics learning outcomes of grade IV students. The success of this innovation is expected to be an alternative solution for teachers in compiling effective and interesting mathematics learning.

Based on this description, the purpose of this study is to improve the mathematics learning outcomes of grade IV students of Bakalan Krajan 1 Public Elementary School, Malangthrough the application of the Discovery Learning learning model assisted by interactive e-book media. With this approach, it is hoped that students can be more active, motivated, and able to understand mathematical concepts independently through a fun learning experience.

Method

This research is a Classroom Action Research with the Kemmis & McTaggart spiral model which consists of four stages, namely planning, implementation of actions, observation, and reflection in each learning cycle. The subjects of this study are 28 students of class IV B Bakalan Krajan 1 Public Elementary School Malang in the even semester of the 2024/2025 school year. The research was carried out during two learning cycles with each cycle consisting of two meetings. The learning model applied is Discovery Learning assisted by interactive e-book media which is integrated into the action implementation stage, through learning scenarios designed from the planning phase. The research procedure begins with compiling learning tools and research instruments, followed by the implementation of actions according to the stages of Discovery Learning, observing student activities and the course of learning, and ending with reflection on the results to determine improvements in the next cycle. The data collection technique uses learning outcome tests given at the pre-cycle, end of cycle I, and end of cycle II,

as well as observation of the learning process. The learning outcome data was analyzed in a quantitative descriptive manner by calculating the average score and percentage of learning completeness in each cycle to see an increase in student learning outcomes. All of these methods were applied to measure the effectiveness of the application of the interactive e-book-assisted Discovery Learning model in improving the mathematics learning outcomes of elementary school students.

Results and Discussion

Results

Learning Outcomes in the Pre-Cycle Stage. In the pre-cycle stage, students of grade IV B Bakalan Krajan 1 Public Elementary School Malang, were given a formative test to find out the initial learning results. Based on the test results, 10 students (35.7%) who reached the Minimum Completeness Criteria ≥75 and 18 students (64.3%) have not reached the Minimum Completeness Criteria. The highest score of students was 95, the lowest score was 20, with a total score of 1,745 and a class average of 62.32.

Learning Outcomes in the Cycle I Stage. The implementation of the first cycle was carried out in two meetings. In the first meeting, as many as 15 students (53.5%) achieved completeness, while 13 students (46.5%) did not complete. The highest score was 100, the lowest score was 50, and the class average was 78.2. At the second meeting, the number of students who completed increased to 17 people (60.7%) with an average score of 77.32.

Learning Outcomes in Cycle II Stage

In cycle II, learning outcomes have increased again. In the first meeting, as many as 22 students (78.5%) achieved completeness, with the highest score of 100, the lowest score of 65, and the class average of 80.35. In the second meeting, the number of students who completed increased to 24 people (85.7%) with an average score of 81.7.

Learning Outcome Recapitulation

The recapitulation of student learning outcomes from the pre-cycle stage to cycle II can be seen in Table 1 below:

Table 1. Recapitulation of learning outcomes at the pre-cycle, cycle I and cycle II stages

No	Cycle	Average Student Value	Individual Completeness		Classical Completeness
			Conclusion	Incomplete	
1	Pre-cycle	63,32	10 (35,7 %)	18 (64,3%)	Incomplete
2	Cycle I Meeting I	78,2	15 (53,5%)	13 (46,5%)	Incomplete
3	Cycle I Meeting II	77,32	17 (60,7%)	11 (39,3%)	Incomplete
4	Cycle II Meeting I	80,35	22 (78,5%)	6 (21,5%)	Conclusion
5	Cycle II Meeting II	81,7	24 (85,7%)	4 (14,3%)	Conclusion

The results of the study show that the application of the Discovery Learning learning model assisted by interactive e-book media can improve the mathematics learning outcomes of students in grade IV B of Bakalan Krajan 1 Public Elementary School, Malang. The increase in learning outcomes was seen significantly from the pre-cycle stage to cycle II, where classical completeness which was originally only 35.7% increased to 85.7% at the end of cycle II.

This increase in learning outcomes is in line with the characteristics of the Discovery Learning model which places students as active subjects in learning, with the process of finding concepts through observation, data collection, information processing, and concluding material (I. P. Rahayu et al., 2019). Learning with discovery learning has been proven to be able to increase student engagement and motivation because it requires them to think critically and solve problems directly (D. Rahayu et al., 2023).

In addition, interactive e-book media used in learning also contributes positively to improving learning outcomes. Interactive e-books that contain materials in the form of texts, videos, pictures, educational games, and evaluations make learning more interesting and in accordance with the learning styles of elementary school-age students (Rusdiana & Wulandari, 2022; Kurniasih, 2019). Providing guidance on the use of e-books at the beginning of the second cycle is also a factor in increasing learning outcomes because students are better prepared to participate in technology-based learning.

Discussion

The results of this study are in line with the findings of Janawati et al. (2021) who stated that the use of interactive-based digital learning media can improve learning outcomes and student involvement. The application of the Discovery Learning model combined with interactive digital books has been proven to create a more interesting and participatory learning atmosphere, especially for elementary school students who have visual, audio, and interactive activity-based learning needs (Umayah, 2019). The significant increase in learning outcomes in cycle II is likely due to the gradual adaptation of students to interactive e-book media and the optimization of the implementation of the Discovery Learning stages, especially when teachers are more consistent in facilitating the exploration, discussion, and presentation of student findings. In addition, the self-study experience through e-books encourages students to be more active in seeking information and understanding the concept of building flat contextually.

However, this study has a number of limitations that need to be examined. One of them is the challenge in the early stages of using interactive e-books, where most learners experience technical difficulties in operating the device. Although this problem can be overcome through intensive mentoring, this situation shows that the application of digital media in elementary school still requires technological readiness and basic digital literacy. In addition, research designs that are only conducted in a relatively short time and involve one class have an impact on the limitations of generalization of results. These findings may not necessarily be applicable in other schools with different conditions, student characteristics, and technological facilities.

The implications of this study are, practically, providing recommendations for elementary school teachers to systematically integrate the interactive digital media-assisted Discovery Learning model in mathematics learning. The use of interactive e-books is not only effective in improving learning outcomes, but also trains students to get used to using educational technology from an early age. On the other hand, similar research should be developed with a wider range of subjects, longer duration of actions, and variations of other mathematical material to test the consistency of the effectiveness of these models in more diverse learning contexts.

Conclusion

Based on the results of the research that has been conducted, it can be concluded that the application of the Discovery Learning learning model assisted by interactive digital books is effective in improving the mathematics learning outcomes of grade IV students of Bakalan Krajan 1 Public Elementary School, Malang. This is shown by the increase in student learning completeness from 35.7% in the pre-cycle to 60.7% at the end of the first cycle, and reached 85.7% at the end of the second cycle, with the average class score increasing from 62.32 to 81.7. This success is supported by the characteristics of Discovery Learning that encourages active involvement of students in finding concepts, as well as interactive digital book media that facilitates the visualization of abstract materials, so that learning becomes more interesting, meaningful, and able to improve student understanding. The practical implications of this study are that elementary school teachers are advised to start using interactive digital media as a support for mathematics learning, especially in visual and abstract materials, so that students can more easily understand concepts. In addition, further research is recommended to expand the subject and study materials, test the effectiveness of these interactive digital media at the lower or higher grade level, and explore their impact on non-cognitive skills such as student creativity and collaboration.

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Authors' Note

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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