The Implementation of PBL Using PANTODA Media to Enhance the Creative Thinking Skills of Fourth-Grade Students

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ABSTRACT

Students' low levels of creative thinking, particularly regarding pictogram material, pose a major challenge in fourth-grade mathematics instruction at SDN 1 Ngargosari. This problem stems from a learning process that remains mechanistic and teacher-centered, as well as a lack of concrete teaching aids that can stimulate student exploration. To address this issue, this study aims to enhance students' mathematical creative thinking skills through the implementation of the Problem-Based Learning (PBL) model supported by the PANTODA (Pictogram and Data Diagram Board) medium. This study employs a Classroom Action Research (CAR) approach using the Kemmis and McTaggart model design, conducted over two cycles. Each cycle includes the planning, implementation, observation, and reflection stages. The research subjects were 11 fourth-grade students at SDN 1 Ngargosari during the odd semester of the 2024/2025 academic year. The data collection instruments used consisted of a creative thinking ability test (measuring the aspects of fluency, flexibility, originality, and elaboration) and an observation sheet for student activities. The research results are expected to show that the integration of the PBL model, which challenges students through authentic problems using PANTODA as a visual-concrete aid, is capable of stimulating the flexibility and originality of students' ideas in presenting data. Thus, the use of the PANTODA media, supported by the PBL model, is worth recommending as an innovative solution for improving the quality of mathematics education in elementary schools.
Keywords: Problem-Based Learning; PANTODA Media; Creative Thinking; Mathematics.

INTRODUCTION

From elementary school through higher education, educators consistently emphasize the importance of fostering a mindset that builds character centered on logical, critical, creative, and innovative thinking

(Fitriani & Jusra, 2024; Mahmudah & Salimi, n.d.; Windi Putri Lestari, 2024; Yayuk et al., 2020). Every program or subject has been designed in a way that allows values to strengthen character; this is the goal of education. Mathematics is one field of education that aims to develop the ability to think logically, analytically, critically, systematically, and creatively to solve existing problems (Habibah Pasaribu, 2021). The Merdeka Curriculum was created by the government as a standard for the design, implementation, and evaluation of learning in an effort to improve the quality of education. The 2013 Curriculum aims to enhance students' creativity (Anggraini et al., 2020). Activities such as observing, questioning, exploring, associating, and communicating are part of the scientific approach, which is a hallmark of the 2013 Curriculum. Students have the opportunity to enhance their creative thinking skills through these activities. The goal of mathematics education is to enhance students' logical, analytical, critical, systematic, and creative thinking skills for problem-solving. Mathematics instruction emphasizes the development of higher-order thinking skills, which require students to manipulate data and ideas to generate new insights and implications (Munarsih and Hasibuan 2019; Habibah Pasaribu, 2021). Creative thinking skills are essential for higher-order thinking because they determine the number of possible solutions to a given problem. The ability to discover various solutions is essential in higher-order thinking. Predictive ability is the capacity to consider these various possibilities. In other words, this ability is referred to as the ability to think broadly or divergently. Creative thinking skills are highly beneficial in fostering excellent mathematical thinking abilities (Pasaribu, Suriyani, and Masitah 2018; Habibah Pasaribu, 2021).

In the elementary school curriculum, mathematics is crucial for developing logical, critical, and creative thinking skills. However, mathematics instruction today often focuses on lower-level cognitive skills (C1–C3). Nevertheless, a crucial learning objective is the incorporation of creative elements such as elaboration, originality, fluency, and flexibility. The development of these skills is particularly vital at the elementary education level, as this stage is central to children's social, cognitive, and emotional development (Nur Halisa et al., 2025). Mathematical creative thinking is a skill that students must possess. Mathematical creative thinking refers to an individual's ability to think with the aim of discovering new, distinct ideas—or even creating novel, unconventional, and original ideas—that yield precise and accurate results. High-order thinking skills (HOT) categorize mathematical creative thinking as one of their components (Faturohman & Afriansyah, 2020; Restu Tera Astria, 2023). Mathematical creative thinking is considered vital in the educational process. Teaching students to think more complexly and critically when solving mathematical problems is essential for fostering mathematical creative thinking. The ability to view problems from different or broader perspectives (Nadia Astuti & Widianti Utami, 2025)

The ideal conditions for a mathematics class are when the learning environment encourages students to seek various ways to solve open-ended problems. Unfortunately, field analysis reveals that fourth-grade students have poor creative thinking skills, particularly regarding topics that require a high degree of abstraction. When presented with varied problems, students tend to merely memorize formulas without understanding the meaning of the concepts, resulting in rigid thinking (Hidayah et al., 2021). Currently, mathematics education requires a change. Students must be trained in creative thinking skills from elementary school through high school to help solve problems in their studies, such as in mathematics. However, field research indicates that creative thinking skills are not being utilized effectively. This is due to students' lack of self-confidence, as well as their perception that mathematics is a difficult subject. Educators also struggle to identify and determine formulas to solve mathematical problems (Andiyana et al., 2018) (Habibah Pasaribu, 2021). In the current situation, the learning process must be transformed to help students enhance their mathematical creative thinking skills. A differentiated learning model can achieve this. Differentiated learning is an educational approach that takes into account students' needs in terms of their readiness to learn, learning profiles, interests, and talents. It is considered to have the potential to help students learn and is tailored to their abilities, preferences, and needs (Evendi et al., 2023).

As a solution to this problem, the implementation of the Problem-Based Learning (PBL) model is considered highly relevant due to its focus on authentic, real-world problems. PBL compels students to actively engage in investigative stages that stimulate critical and creative thinking. The Problem-Based Learning (PBL) model is one of the instructional models teachers can use to achieve learning success by teaching students to think creatively and independently. Problem-Based Learning (PBL) gives students the opportunity to learn academic content and problem-solving skills by engaging in various real-life situations. This demonstrates that most ideas or generalizations can be effectively introduced through problems. This specific learning approach has several features that distinguish it from other learning methods. Mathematical creative thinking is the ability to discover and solve mathematical problems in various ways or with different solutions, not being satisfied with the results, and always developing ideas with answers that are unique and different from the usual ones. Mathematical creative thinking also involves the ability to identify and solve mathematical problems using the following components: fluency, flexibility, elaboration, and originality. Mathematical creative thinking refers to the ability to solve mathematical problems easily and flexibly. Fluency, flexibility, elaboration, and originality are components of creative thinking, based on the attributes mentioned earlier (Hardiyanti Ali, 2024).

Based on the results of observations, students have not yet demonstrated the ideal condition—namely, poor creative thinking skills. To ensure that the PBL process for fourth-grade students runs effectively, visual aids in the form of PANTODA (Pictogram and Data Diagram Boards) are needed. This medium serves as a concrete teaching aid designed to bridge abstract statistical concepts into tangible visual representations for elementary school-aged children. The integration of the PBL model and the PANTODA media enables collaboration between the inquiry process and physical manipulation, thereby reducing students' cognitive load and increasing their creative space. Given this urgency, this research is urgently needed to empirically demonstrate how the synergy between the model and the media can improve the quality of mathematics learning (Sari et al., 2023).

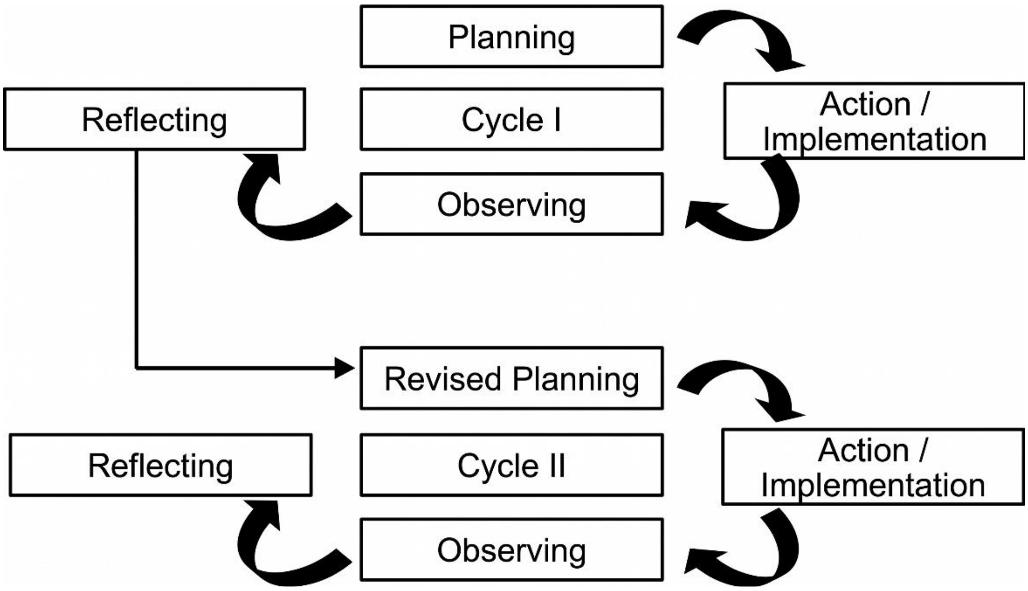
The integration of the Problem-Based Learning (PBL) model and PANTODA media creates a learning synergy that focuses on collaboration between the problem-solving process and the use of concrete aids. In practice, PBL provides a framework or line of reasoning that challenges students through contextual problems, while PANTODA media serves as a physical tool that facilitates the exploration of those solutions. This collaboration is crucial in sparking creativity among fourth-grade students, as creative thinking cannot emerge in a vacuum without visual and manipulative stimuli. When students are in the investigation phase of the PBL process, PANTODA media allows them to conduct experiments with data presentation directly. Students can try various variations of pictogram shapes or change the scale of bar charts simply by sliding or placing components on the board, which directly supports the aspect of flexibility in thinking (Nurkhalizah, 2023).

Based on the gap between the ideal curriculum and the reality on the ground, it can be concluded that research on the implementation of the Problem-Based Learning (PBL) model supported by the PANTODA media is urgently needed. This urgency stems from the pressing need to transform statistics instruction in elementary schools, which has thus far remained mechanistic and lacking in creative exploration. Without the intervention of a challenging model and concrete media, the low level of creative thinking among fourth-grade students will persist, ultimately hindering the achievement of numeracy literacy within the Merdeka Curriculum. As emphasized by Nurkhalizah (2023), the integration of problem-based learning models with manipulative media is no longer merely an option but a necessity to ensure students are not merely consumers of data but also creative creators of information. Therefore, this classroom action research serves as a strategic and crucial step to provide practical solutions as well as theoretical contributions toward improving the quality of mathematics education at the elementary school level (Hidayat & Pratama, 2022).

METHOD

This study is a classroom action research project aimed at improving students' creative thinking skills through systematically designed instructional interventions. The research design employs the cyclical model proposed by Kemmis and McTaggart, consisting of four main stages: (1) planning, (2) implementation of actions, (3) observation, and (4) reflection.

Figure 1:
Research Phases



FINDINGS AND DISCUSSION

The procedure used in this study consisted of two cycles with 11 fourth-grade students from SDN 1 Ngargosari, Sukoharjo District, Kendal Regency, as research subjects during the odd semester of the 2024/2025 academic year. The research activities were conducted on October 1, 2025. More specifically, Cycle I took place on October 20, 2025, and Cycle II on October 28, 2025. The problem addressed was students' learning outcomes that had not yet reached their maximum potential in the mathematics subject, specifically regarding pictograms and bar charts. This study aimed to improve students' learning outcomes through the application of the Problem-Based Learning model assisted by the PANTODA media. PTK Subjects: Characteristics of fourth-grade students (number of students, location, and time of implementation).

The Minimum Passing Grade (KKM) for fourth-grade students at SDN 1 Ngargosari for the 2024–2025 academic year is a score of 76. The use of the PANTODA media in the mathematics learning process is considered successful if students achieve a score of 76 or higher. This score is obtained from the results of a posttest or evaluation questions that measure students' cognitive achievement. The calculation of individual learning achievement scores uses equation (1) (Arifin, 2016).

$$S = \frac{B}{N} \times 100$$

Note: S is the individual mastery score; B is the student's achieved score; and N is the total score. Classical learning is considered successful if students achieve a score of 76 or higher, with a passing rate of 85%. The percentage of classical learning mastery can be calculated using equation (2) (Arifin, 2016).

The data analysis techniques used in this study involved both qualitative and quantitative data analysis. Qualitative data analysis was used to process data obtained from observations of teachers and students during the learning process. Qualitative data was analyzed descriptively by examining, grouping, and interpreting the results of the observations to describe the implementation of Problem-Based Learning using PANTODA media and the levels of student engagement.

Quantitative data analysis is used to process data from tests of students' creative thinking abilities. Quantitative data is analyzed using percentage techniques to determine the level of student learning achievement on a class-wide basis. Percentage calculations are performed by comparing the number of students who achieved the "Creative" category with the total number of students, then multiplying by one hundred percent. The numerical learning outcomes were then described through descriptive assessment. The achievement levels are presented in Table 1 (Arifin, 2016).

Table 1:
Success Rates

Interval Score (%)	Category
90 ≤score ≤ 100	Excellent
80≤ score ≤ 90	Good
70≤ score ≤80	Fair
60≤ score ≤70	Poor
≤ 59	Very Poor

1. Results of the Action Research

Table 2:
Research Schedule

No	Activity	Exucution
1	Pre Cycle	October 17, 2025
2	Cycle 1	October 20, 2025
3	Cycle 2	October 28, 2025

Pre-cycle

During the pre-cycle stage, the researcher conducted direct observations of mathematics instruction in the fourth-grade class at SDN 1 Ngargosari to identify the root causes of students' low creative thinking skills. The observation results showed that the learning process was still dominated by a traditional, teacher-centered approach, in which material was delivered orally without the use of concrete learning media. Specifically regarding pictogram material, students only received explanations through textbooks and the blackboard, resulting in monotonous learning activities that failed to motivate students to actively engage. This situation led to low levels of students' mathematical creative thinking skills, particularly in terms of flexibility and originality, as students tended to merely memorize formulas without understanding the underlying concepts behind the presented data.

Figure 2:
Preliminary Observations Through Teacher Interviews

Based on the results of the observations, most students demonstrated low levels of creative thinking. This issue was further supported by the analysis, which showed that fourth-grade students exhibited rigid thinking when faced with open-ended math problems. This shortcoming was evident in the students' passive attitudes, lack of confidence, and negative perception that mathematics is a difficult subject. In addition to observations, the researcher also conducted a cognitive pre-assessment to map students' abilities, the results of which confirmed that most students have not yet been able to reach an ideal state in exploring problems independently. The findings from this pre-cycle phase underscore the urgency of implementing an intervention through the application of the Problem-Based Learning (PBL) model, supported by the PANTODA (Pictogram and Data Diagram Board) medium, to transform abstract concepts into tangible visual representations for students in the subsequent cycle.

Action Planning for Cycle I

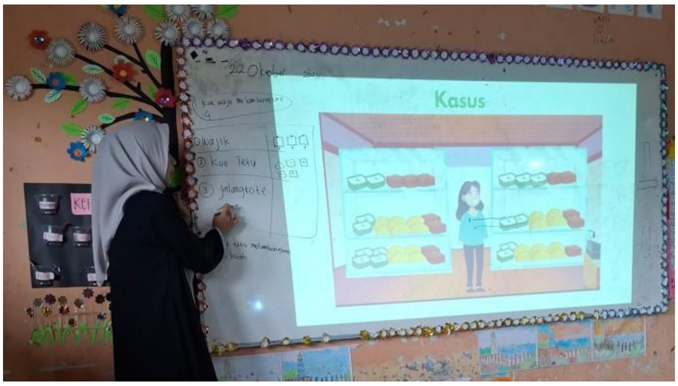
During the planning phase of Cycle I, the researcher designed a learning strategy aimed at improving students' mathematical creative thinking skills through the application of problem-based learning (PBL). The planning process begins with: (1) Developing a Lesson Plan (RPP) based on the PBL framework, which includes problem orientation, student organization, investigation, presentation of results, and reflection. (2) A pre-test instrument to assess creative thinking skills in mathematics is designed to measure students' initial competencies before the learning process begins. This assessment tool is designed as open-ended questions, giving students the opportunity to freely express their ideas, strategies, and arguments in accordance with their understanding. In developing the pre-test questions, the primary focus is on indicators of mathematical creative thinking ability, which include fluency, flexibility, originality, and elaboration. The fluency indicator serves to assess the extent to which students can generate many ideas or answers relevant to the questions asked. Furthermore, the flexibility indicator aims to evaluate students' ability to apply various different methods or problem-solving strategies. The originality indicator is used to measure the extent to which students can generate innovative answers or solutions that are not commonly used by other students. On the other hand, the elaboration indicator focuses more on students' ability to develop answers in a comprehensive, structured, and logical manner. By utilizing these four indicators, it is hoped that the pre-test instrument can provide comprehensive insights into students' mathematical creative thinking abilities as a foundation for action in the upcoming cycle. (3) The instructional media, designed in PowerPoint (PPT) format, presents material on pictograms and bar graphs packaged through contextual issues relevant to students' daily lives.

This material was selected because it requires students to analyze data, understand information, and restate data in different graphical forms, which can stimulate the development of creative thinking skills in mathematics. In the PPT, students are presented with contextual situations such as data on favorite foods, the ratio of male to female students in several classes, and comparisons of the number of objects commonly found around the school. With these issues, students are expected to demonstrate accuracy in answering, flexibility in choosing data presentation methods, originality in creating engaging diagrams, and the ability to explain the results of data analysis in detail. In other words, the pictograms and bar graphs in the PowerPoint presentation are specifically designed to help students enhance their creativity in effectively understanding, processing, and presenting mathematical data. (4) Developing an observation sheet to monitor student and teacher activities during the learning process. This plan is based on findings from previous research showing that PBL and problem-solving methods effectively improve students' mathematical creative thinking skills when supported by appropriate learning media (Dewi & Harjono, 2021; Fitriani & Jusra, 2024; Hidayat Taufik et al., 2024; Sari Purnama, 2024).

Implementation of Cycle I

Cycle I was implemented in a single learning session. The activity began with a pre-test to assess the students' initial mathematical creative thinking skills before implementing the learning model. After that, the teacher explained the learning objectives and motivated the students by presenting a PowerPoint presentation containing material on contextual problems in mathematics. The teacher presented an initial problem that the students needed to solve in groups. At this stage, students were encouraged to share various ideas and solution strategies.

Figure 3:
Problem Statement



During the discussion process, the teacher acts as a facilitator who provides guidance and asks probing questions to help students develop their ideas more creatively. At the end of the lesson, the teacher and students reflect together on the problem-solving process they have gone through. This activity aims to reinforce conceptual understanding and raise students' awareness of the importance of creative thinking in solving math problems.

Observation of Initial Test Results on Creative Thinking Skills

The results of the pre-test on creative thinking skills in mathematics indicate that, overall, students' initial abilities remain at a low to moderate level. Analysis of the test results reveals that the majority of students: (1) still tend to choose a single solution method without considering available alternatives; (2) are not yet able to elaborate on and explore their answers in depth; (3) Experience difficulty in generating new or unique ideas. Of the four indicators of creative thinking, signs of fluency and flexibility are beginning to emerge, but the indicators of originality and elaboration remain at a low level. These findings align with research conducted by (Hidayah et al., 2021), which states that students' creative thinking skills at the beginning of mathematics instruction generally have not yet developed to their full potential.

Reflection on Cycle I

Based on the results of the interventions and observations during Cycle I, the use of the Problem-Based Learning (PBL) model, supported by PowerPoint presentations on pictograms and bar charts, showed an increase in student participation during learning activities. Students began to actively participate in group discussions, express their opinions, and attempt to solve the problems presented. However, despite this increase in participation, their mathematical creative thinking skills have not yet improved optimally, particularly in terms of originality and elaboration.

These results indicate that although students demonstrated engagement, many of them still tended to use the same problem-solving methods or imitate examples demonstrated by the teacher. This suggests that learning in Cycle I has not yet fully addressed the limitations in creative thinking, particularly in generating original ideas and developing answers in greater depth. These findings align with research conducted by Dewi and Harjono (2021), which revealed that the implementation of PBL in the early phases focuses more on increasing learning engagement, whereas enhancing creativity requires gradual habituation and reinforcement.

In addition, the findings also revealed that some students still require more guidance in articulating their ideas and developing diverse solutions. This demonstrates that the learning approach implemented in Cycle I has not yet been fully and effectively implemented, particularly in providing students with sufficient opportunities for independent exploration. Fitriani and Jusra (2024) emphasize that mathematical creative thinking skills will develop more effectively if students are given ample opportunities to try various strategies without excessive direct intervention from the teacher.

Another finding that emerged was the time constraint for discussion. The duration allotted in Cycle I was deemed suboptimal, resulting in some groups being unable to present their ideas in a thorough and well-organized manner. Consequently, the elaboration indicator did not develop adequately. This finding aligns with the perspective of Hidayat Taufik et al. (2024), who state that time constraints in problem-based learning can hinder students from comprehensively designing and communicating creative ideas. On the other hand, teachers still tend to provide fairly structured problem-solving examples, so the space for creative thinking among students has not yet been fully established. However, according to Sari Purnama (2024), it is important to provide open-ended problems and varied prompting questions to encourage the emergence of originality and variety in students' ideas. Therefore, in Cycle I, it can be concluded that improvements in creative thinking skills remain limited and uneven across all indicators, necessitating corrective actions in the subsequent cycle.

Based on these reflections and discussions, improvements in Cycle II will focus on clarifying students' roles in group discussions, adding more variety to the contextual problems in the PowerPoint presentation, and providing specific reinforcement on the indicators of originality and elaboration. These improvement steps align with previous research findings that emphasize that enhancing creative thinking skills in mathematics requires a gradual process through a continuous action cycle (Dewi & Harjono, 2021; Fitriani & Jusra, 2024; Hidayat Taufik et al., 2024; Sari Purnama, 2024).

Action Planning for Cycle II

Activities in Cycle 2 were carried out based on the challenges identified in Cycle I. The activities were conducted using the PANTODA platform and the PBL model. They were implemented effectively, and students appeared very enthusiastic as they worked on the problems in the worksheets by attempting to create pictograms and bar charts using PANTODA. The PANTODA platform was effectively utilized as an interactive tool that facilitated students' understanding of the material through the visual presentation of data via pictograms and bar charts. The learning process proceeded smoothly and orderly, with the teacher providing guidance to students according to their individual ability levels in a more interactive manner.

Implementation of Cycle II

The implementation of Cycle II took place during the next session on October 28, 2025, using the revised Problem-Based Learning (PBL) steps. The lesson began with an introductory activity, the presentation of learning objectives, and the provision of examples of simple pictograms and bar charts to reinforce initial concepts. The teacher then presented contextual problems related to data collection and presentation in students' daily lives. Students worked in small groups to collect data and present it in the form of pictograms and bar charts using the PANTODA software. During the inquiry phase, the teacher provided step-by-step guidance and encouraged students to try various alternatives for data presentation and to explain the reasons for their choices.

Figure 4:
Introduction to the PANTODA Board

Action Research Cycle II

The results of the observations on the mathematical creative thinking test in Cycle II showed a significant improvement compared to the test results in Cycle I. Most students were able to present data in the form of pictograms and bar charts more accurately, neatly, and systematically. The fluency indicator is evident in students' ability to provide answers appropriate to the problem without encountering significant difficulty. The flexibility indicator also showed improvement, demonstrated by students' ability to present data using more than one form of representation. Additionally, the elaboration indicator developed well, as seen in students' more detailed and structured explanations regarding the process of data collection, processing, and presentation.

Overall, the test results indicate that the majority of students have reached the "creative" category. Classically, more than 75% of students met the established mastery criteria. This indicates that the implementation of the PBL model assisted by the PANTODA media in Cycle II was more effective and capable of enhancing students' mathematical creative thinking skills.

Reflection on Cycle II

Based on the results of the implementation of interventions and observations in Cycle II, it can be concluded that the application of the Problem-Based Learning (PBL) model supported by the PANTODA media successfully improved students' mathematical creative thinking skills to the fullest extent. Challenges identified in Cycle I, such as limited data presentation variations and low elaboration skills, were minimized through improvements in lesson planning and implementation during Cycle II. Students demonstrated growth in learning independence, group collaboration skills, and confidence in expressing ideas and explaining their work. The discussion and presentation processes were more active, and students appeared more confident in expressing their opinions. The teacher was also able to fulfill the role of a facilitator more effectively by providing targeted guidance tailored to students' needs. With the achievement of the research success indicators in Cycle II, this classroom action research is deemed successful and does not need to be continued to the next cycle.

CONCLUSION

Based on the results of the study conducted over two cycles, it can be concluded that the use of PANTODA (Pictogram and Bar Chart Boards) effectively improved the mathematics learning outcomes of fourth-grade students in the area of data presentation. This effectiveness is evidenced by a significant upward trend in average learning outcomes from the pre-cycle stage through Cycle I to Cycle II, with a final class-wide mastery rate of 88%, which falls into the "Good" category. This success is closely tied to the PANTODA medium's ability to capture students' attention, simplify abstract concepts into more concrete forms, and stimulate active participation in the learning process. Thus, the PANTODA medium has proven to be an innovative solution capable of addressing students' learning difficulties while creating a fun and meaningful learning experience. It is hoped that these results will encourage teachers to continue developing creative learning media tailored to students' needs and characteristics in order to improve the quality of mathematics education in elementary schools.

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