

Improving Second-Grade Students' Mathematics Learning Outcomes On Diagram Topics Through The Papan Tempel Data Media

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Abstract

This study aimed to improve second-grade students' mathematics learning outcomes on diagram topics through the use of the Papan Tempel Data media at SDN Cipondoh 5. This study was motivated by the low learning outcomes of students on the topic of diagrams, with an initial average score of 56.25 and a learning mastery rate of 37,50%. The study employed Classroom Action Research (CAR) using the Kemmis and McTaggart model, conducted in two cycles, each consisting of two meetings. The research subjects were 32 second-grade students at SDN Cipondoh 5. Data were collected through observations, learning outcome tests, and documentation, and were analyzed using descriptive qualitative and quantitative methods. The results showed an improvement in students' learning outcomes following the use of Papan Tempel Data media. In Cycle I, 21 students (65.63%) achieved the minimum mastery criterion, while in Cycle II, this number increased to 28 students (87.50%). Student learning activities also increased from 77% in Cycle I to 95% in Cycle II. These findings indicate that the use of Papan Tempel Data media facilitated students understand diagram concepts more concretely, increased their engagement in the learning process, and improved their mathematics learning outcomes. Therefore, Papan Tempel Data media can be used as a concrete and interactive alternative learning medium for teaching mathematics to second-grade elementary school students.

Keywords: Mathematics Learning Outcomes; Diagrams; Papan Tempel Data; Learning Media; Elementary School.

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INTRODUCTION

Mathematics is a discipline that plays a fundamental role in education. It is a precise subject that is closely related to logical reasoning that can be accepted by the mind (Andriliani et al., 2022). The purpose of mathematics instruction is to improve students' understanding and reasoning, as well as their ability to deal with problems, both mathematical problems and real-life problems (Mawardah et al., 2023). This aim is in line with the view that mathematics in elementary school is expected to equip students with the ability to understand concepts, reason, and solve problems. Mathematics is closely related to everyday life because, through mathematics, students not only learn to calculate but are also trained to think systematically, logically, and critically in understanding various situations, so that the skills they acquire can be applied directly to solve present problems as well as future life challenges.

Although mathematics plays a very important role in everyday life, it is often perceived as a difficult subject, full of formulas, and frightening, which frequently gives rise to misconceptions among students. The abstract nature of mathematics is one of the main causes of these misconceptions, because students find it difficult to understand these abstract concepts and to connect them with their real experiences (Cahyani et al., 2023). This condition calls for learning strategies that can bridge abstract mathematical concepts so that they match students' characteristics and learning needs. It also points to the need for learning approaches that are concrete and suited to students' cognitive characteristics, particularly for lower-grade students such as those in the second grade of elementary school, who are generally around 7–8 years old. According to Piaget's theory of cognitive development, students in this age range are in the concrete operational stage, in which logical thinking has begun to develop but still depends heavily on real objects or direct experience for understanding a concept (Rizqiyati & Wardani, 2023). Learning with concrete objects and direct experience can minimize mathematical misconceptions and provide more meaningful conceptual understanding.

Building an enjoyable learning atmosphere is also necessary in providing mathematics learning experiences for second-grade students. Designing mathematics instruction for second-grade students requires media that connect mathematical concepts with the context of everyday life, so that lessons become easier to understand (Riyana et al., 2020). In addition, the learning process needs to be designed in an engaging and interactive manner so that students can be actively involved throughout learning activities. Students' activeness in the learning process influences the learning outcomes achieved. Mathematics learning outcomes are also influenced



by internal and external factors. Internal factors include low learning motivation and difficulty in understanding the material, whereas external factors stem from a non-conducive learning environment, less effective teaching methods, and the use of unengaging learning media (Oktaviani et al., 2020). These factors affect mathematics learning outcomes, especially on diagram topics, which requires the ability to understand, process, and present information accurately.

Although the various factors affecting mathematics learning outcomes are already known and numerous instructional efforts have been made, the reality in the field shows that several problems remain that result in low student learning outcomes. This was identified through an interview with the second-grade teacher of SDN Cipondoh, which showed that student learning outcomes on the topic "Getting to Know Diagrams" were still relatively low. Among the 32 students who took part in the lesson, the average score obtained was 56.25 and the learning mastery percentage reached only 37,50%, so that most students had not yet met the Minimum Mastery Criterion (KKM). In addition, several difficulties experienced by students in learning this material were found. Some students still had difficulty reading and interpreting the information presented in diagrams, as well as drawing conclusions from the data presented. During the learning process, students tended to be less active and easily lost focus because instruction was still dominated by teacher explanations with limited media. The teacher only mentioned examples without showing the actual objects and immediately wrote the results on the whiteboard. This condition shows the need for learning media that can improve conceptual understanding, activeness, and student learning outcomes on the topic "Getting to Know Diagrams."

The use of concrete and interactive learning media is one alternative for improving the quality of learning in elementary schools. Concrete media are defined as real objects that students can see, touch, and manipulate directly to bridge abstract concepts into something more tangible (Hendriani, 2021). Concrete media help students understand concepts through direct learning experiences, increase involvement in learning, and create a more active and meaningful learning process (Pujianto et al., 2025). Various studies show that concrete media can create more active and meaningful learning. On data presentation material, the development of diagram-board-based media has proven effective in helping elementary school students understand data concepts through reading, arranging, presenting, and interpreting diagrams (Berliana & Budiyo, 2024). The use of visual diagram-board media is effective in helping



students understand data presentation and improving mathematics learning outcomes (Silvia Masithoh & Wijayanti, 2024). The use of diagram-board media has also been shown to increase student involvement and learning outcomes because it helps visualize data in a more tangible and easily understood way (Latifaturrodhita et al., 2023). Thus, the use of concrete and interactive learning media has the potential to overcome various difficulties that students face in learning material related to data presentation and diagrams.

Based on these problems, concrete and interactive learning media are needed to help students understand how to read, arrange, and present data in the form of diagrams. One medium that can be used is the “Papan Tempel Data”, a magnetic board equipped with picture-bearing pieces that students can attach and move to arrange data into tables and diagrams. This medium was previously developed by Mahira Syahwa and Ritonga (2025) for mathematics learning on “Getting to Know Diagrams” in the first grade at SDN 03 Jembatan Lima. The use of the “Papan Tempel Data” showed very positive results, indicated by feasibility levels of 82% from the media expert and 88% from the material expert, both in the very feasible category. In terms of effectiveness, the trial results showed an increase in students’ average score from 68.44 on the pre-test to 84.00 on the post-test in the large-scale trial. In addition, student responses to the use of the medium reached 94.75%, indicating that the medium was well liked and able to increase student involvement in learning (Mahira Syahwa & Ritonga, 2025). These results demonstrate that the “Papan Tempel Data” is effective and feasible for helping students understand the concept of data grouping, read diagrams, interpret data, and improve mathematics learning outcomes through learning that is more concrete, interactive, and enjoyable.

Although the “Papan Tempel Data” has been proven feasible and effective in previous research, differences in student characteristics, classroom conditions, and school environments call for further testing of its effectiveness in improving mathematics learning outcomes. The previous study focused on the development and feasibility testing of the media among first-grade elementary school students, whereas this study focuses on applying the medium as a learning intervention to improve second-grade students' mathematics learning outcomes on diagram topics. Therefore, research on the use of the Papan Tempel Data in a different learning context is needed to test its effectiveness in improving students’ mathematics learning outcomes. Given the low learning outcomes of second-grade students at SDN Cipondoh 5 on diagram topics and the need for more concrete and interactive learning media, the researchers were interested in



applying the “Papan Tempel Data” as an innovation in mathematics learning in that class. Accordingly, this study was conducted as Classroom Action Research (CAR). It aims to improve second-grade students' mathematics learning outcomes on diagram topics through the use of the Papan Tempel Data media. The study is expected to contribute theoretically by enriching the body of knowledge on the use of concrete media in elementary school mathematics learning, particularly on diagram topics. Practically, the results are expected to serve as an alternative for teachers in creating learning that is more interactive, enjoyable, and suited to the characteristics of lower-grade students. The focus of this study covers the improvement of second-grade students' mathematics learning outcomes on diagram topics and the implementation of the Papan Tempel Data as a means of helping students understand the concept of diagrams more concretely and meaningfully.

RESEARCH METHOD

This study used the Classroom Action Research (CAR) method with the cyclical framework of Kemmis and McTaggart (2014), which consists of four stages: Planning, Acting, Observing, and Reflecting (Arikunto et al., 2021). This method was chosen because Classroom Action Research is a form of research carried out through actions given by the teacher to students in the learning process in order to improve the quality of learning and student learning outcomes (Nurhaidah & Alfianti, 2020). The research was conducted at SDN Cipondoh 5 in the 2026/2027 academic year, located in Tangerang City, Banten Province.

The research subjects were all second-grade students of SDN Cipondoh 5, totaling 32 students. The research site was selected based on an interview with the classroom teacher, which showed that students' mathematics learning outcomes on diagram topics were still relatively low. Therefore, this study was conducted as an effort to improve learning through the use of the “Papan Tempel Data.”

The study was carried out in two cycles, with each cycle consisting of two meetings. The stages carried out in each cycle were as follows:

Planning:

In the initial stage, the researcher prepared the learning tools to be used throughout the study, including the Lesson Plan (RPP), the Papan Tempel Data media, the observation sheet, and the evaluation test instrument. These tools were prepared as guidelines for implementing the action in mathematics learning on diagram topics.



Acting:

In the action stage, mathematics learning on diagram topics was carried out according to the prepared Lesson Plan using the Papan Tempel Data media. Through the use of this medium, students were actively involved in grouping data, reading data, interpreting the information presented, and presenting data in the form of diagrams. The action in Cycle II was carried out based on the reflection on Cycle I by correcting the obstacles found during the learning process in order to improve students' understanding and learning outcomes.

Observing:

In the observation stage, the researcher observed the implementation of learning, student activities, and student responses during the use of the Papan Tempel Data media on diagram topics. Observations were made using a prepared observation sheet to obtain objective data on the implementation of the action and the learning process.

Reflecting:

In the reflection stage, data obtained from observations and evaluation tests were analyzed to determine the level of success of the action. The results of the analysis were used to identify the obstacles that arose during the learning process and to evaluate the effectiveness of the action. The findings in Cycle I were then used as the basis for designing improvements to the action in Cycle II in order to increase the effectiveness of learning and student learning outcomes.

Data were collected through several techniques to obtain complete and accurate information, namely:

Observation:

Observation was conducted using a student activity observation sheet to observe students' participation, involvement, and responses during the use of the Papan Tempel Data media on diagram topics. The observation results were used as material for reflection in determining improvements to the action in the next cycle.

Learning Outcome Tests:

The learning outcome test used evaluation questions given at the end of each cycle to measure students' mastery of diagram topics. The test results were used to determine the improvement in learning outcomes and the level of student mastery after learning with the Papan Tempel Data media.



Documentation:

Documentation was used as a supplement to the research in the form of photographs of learning activities and other relevant documents.

Before being used in the study, the research instruments were validated through expert judgment to ensure their suitability for the research objectives. The observation sheet was validated by a lecturer of the Elementary School Teacher Education (PGSD) Study Program and the mentor teacher to assess language aspects, clarity of observation indicators, and measurability of the observed student activities. The learning outcome test was validated by a PGSD lecturer and the second-grade classroom teacher to assess the suitability of the diagram topics, the question indicators, and the appropriateness for the characteristics of second-grade elementary school students.

Observation data were analyzed using quantitative descriptive analysis to describe student activity during learning. The percentage of student activity was calculated using the following formula:

$$\text{Student Activity Percentage} = \frac{\text{Obtained Score}}{\text{Maximum Score}} \times 100\%$$

Learning outcomes were analyzed using quantitative descriptive analysis by calculating the mean score and the percentage of learning mastery in each cycle. The mastery percentage was calculated using the following formula:

$$\text{Learning Mastery Percentage} = \frac{\text{Number of Students Achieved Mastery}}{\text{Total Number of Students}} \times 100\%$$

The research was declared successful if at least 80% of students achieved the Minimum Mastery Criterion (KKM) set by the school, namely 75. The success of the action was also indicated by increases in the mean score and in the mastery percentage of students' learning outcomes in each cycle after the use of the Papan Tempel Data media in mathematics learning on diagram topics.

RESULTS AND DISCUSSION

The results of the study were obtained through two cycles of classroom action, each consisting of two meetings. The actions were carried out according to the prepared plan, including the Lesson Plan, observation sheet, evaluation test, and the use of the Papan Tempel Data media in mathematics learning on diagram topics in the second grade at SDN Cipondoh 5.

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The data obtained are presented based on the mastery of mathematics learning outcomes in the evaluation tests and the observation of student activity during the learning process.

The evaluation test at the end of Cycle I, conducted after learning with the Papan Tempel Data media, showed that of the 32 students who took part in the lesson, 21 students (65.63%) obtained a score of ≥ 75 in accordance with the Minimum Mastery Criterion (KKM), while 11 students (34.38%) had not yet reached the KKM.

Table 1. Student Learning Outcomes in Cycle I

Category	Number of Students	Percentage
Completed (≥ 75)	21	65.63%
Not Completed (< 75)	11	34.38%

Source: Researcher's analysis of student learning outcomes in Cycle I

Based on these results, it can be concluded that most students had understood the diagram topics, but the classical mastery percentage had not yet reached the established success indicator of 80%. The reflection on Cycle I showed that some students still had difficulty understanding the material, so improvements to the learning process were needed in Cycle II.

Improvements were made by adjusting the Lesson Plan, increasing the number of media, and strengthening guidance on the use of the media during the learning process. After the action in Cycle II was carried out, students were again given an evaluation test to determine the improvement in learning outcomes after the revised action. The evaluation test at the end of Cycle II showed that 28 students (87.50%) obtained a score of ≥ 75 in accordance with the KKM, while 4 students (12.50%) had not yet reached the KKM.

Table 2. Student Learning Outcomes in Cycle II

Category	Number of Students	Percentage
Completed (≥ 75)	28	87.50%
Not Completed (< 75)	4	12.50%

Source: Researcher's analysis of student learning outcomes in Cycle II

Based on these results, it can be concluded that there was a significant improvement in student learning outcomes in Cycle II. After the revised action was carried out, the percentage of learning mastery increased by 21.87 percentage points. These results show that the success



indicator of the study was achieved, because the classical mastery percentage exceeded the target of 80% of students reaching the KKM.

The increase in the mastery percentage from 65.63% in Cycle I to 87.50% in Cycle II shows the success of applying the Papan Tempel Data media in improving mathematics learning outcomes. This improvement is seen not only in the quantitative aspect, namely the growing number of students who reached the KKM, but also reflects an improvement in the quality of the learning process. During learning, students showed higher involvement in learning activities.

This finding is reinforced by the results of the observation of student activity carried out during the learning process using the Papan Tempel Data media. The observation results in Cycle I showed that student activity reached 77%, in the good category. Based on the observations, most students had shown interest in using the medium and had begun to take part in learning activities. However, student involvement had not yet been optimal. This was shown by students who were still less active in group discussions, who tended to rely on their friends' answers during question-and-answer sessions, and who had difficulty interpreting and presenting data in diagrams accurately. In addition, the relatively large group size of 6–7 students per group meant that opportunities for students to engage directly with the medium were not evenly distributed. As a result, not all students gained the same experience in manipulating and using the Papan Tempel Data media. This condition is consistent with the evaluation test results in Cycle I, which showed a classical mastery percentage of 65.63%, so the success indicator of the study had not yet been achieved. Therefore, improvements to the action were needed in the next cycle to increase students' active participation and optimize the use of the medium in learning.

The improvements made in Cycle II led to an increase in student activity during the learning process. Student activity reached 95%, in the very good category. This increase was seen in students' more active use of the Papan Tempel Data media, discussion with group members, answering questions, and ability to interpret and present data in diagrams accurately. The increase in activity was supported by regrouping students into groups of 4, so that each student had a greater opportunity to use the medium directly. This made interaction and cooperation within groups more effective and encouraged the involvement of all students in the learning process. Thus, the improvements made in Cycle II succeeded in increasing student learning activity and creating learning that was more interactive, meaningful, and student-centered.

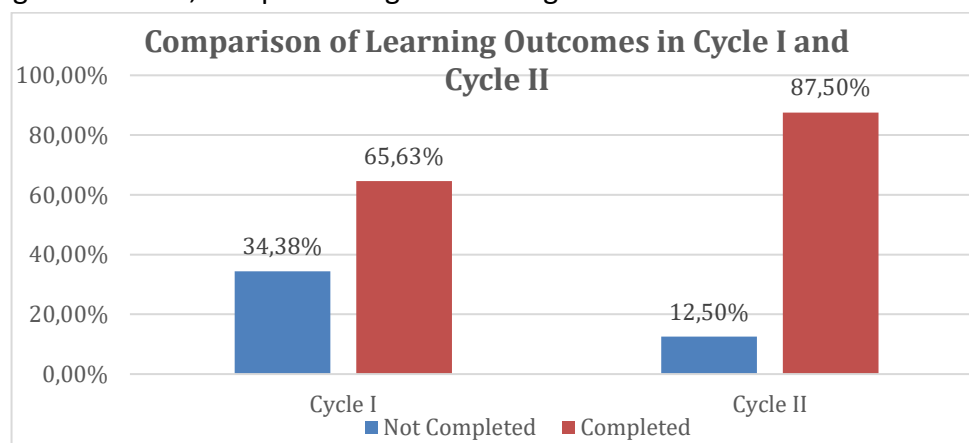


Table 3. Comparison of Student Activity

Cycle	Total Score	Percentage
Cycle I	46/60	77%
Cycle II	57/60	95%

Source: Researcher's analysis of student activity observation data

Based on these results, student activity increased by 18 percentage points. This increase shows that the use of the Papan Tempel Data media was able to increase student involvement during the learning process. More equal opportunities for every student to use the medium directly encouraged active participation in discussion activities, and made reading data, interpreting information, and presenting data in diagrams more effective and meaningful.

**Figure 1. Comparison of Learning Outcomes in Cycle I and Cycle II**

The improvement in learning outcomes from 65.63% in Cycle I to 87.50% in Cycle II shows that the use of the Papan Tempel Data media was able to help students understand diagram topics effectively. These results indicate that learning that makes use of concrete media and actively involves students can create more meaningful learning experiences. Through the activities of grouping data, attaching picture-bearing pieces, reading diagrams, and interpreting data, students had the opportunity to build conceptual understanding through direct experience.

The findings of this study are in line with Piaget's theory of cognitive development, which states that elementary school students are in the concrete operational stage, in which students more easily understand concepts through real objects and direct experience (Rizqiyati & Wardani,

2023). The use of the Papan Tempel Data media helped transform abstract diagram concept into concrete experiences, so that it was easier for second-grade elementary school students to understand.

The results of this study also show that the increase in learning activity went hand in hand with the improvement in student learning outcomes. Students' active involvement in using the medium, in group discussions, and in reading and presenting data helped them construct their own understanding of the concept of diagrams. This condition was supported by the more effective grouping in Cycle II, so that each student had a more equal opportunity to participate in learning. This finding is consistent with Oktaviani et al. (2020), who stated that students' activeness in the learning process influences the learning outcomes achieved.

In addition, the results of this study support the view of Pujianto et al. (2025) that concrete media can increase student involvement and help bridge abstract concepts so that they become easier to understand. Through the use of the Papan Tempel Data media, students gained direct learning experience in grouping, reading, and presenting data, so that their understanding of the concept of diagrams developed better.

This finding is also in line with the study by Berliana and Budiyo (2024), which showed that diagram-board-based media are effective in helping students understand the concept of data presentation through reading, arranging, presenting, and interpreting diagrams. Similar findings were reported by Silvia Masithoh and Wijayanti (2024) and Latifaturrodhita et al. (2023), who stated that the use of diagram media can increase student involvement as well as mathematics learning outcomes on data presentation material.

The results of this study also support the research of Mahira Syahwa and Ritonga (2025), which showed that the Papan Tempel Data media is effective in helping students understand the concept of data grouping, read diagrams, and interpret data. Although applied to different subjects and learning contexts, the medium still demonstrated its effectiveness in improving conceptual understanding and student learning outcomes.

Thus, the use of the Papan Tempel Data media proved effective in improving mathematics learning outcomes on diagram topics among second-grade students at SDN Cipondoh 5. The improvement in learning outcomes was supported by the use of media suited to students' developmental characteristics, increased student involvement during learning, and more equal opportunities to participate in group activities. This shows that the Papan Tempel Data media can



be an effective alternative learning medium for helping students understand diagram topics more meaningfully.

CONCLUSION

Based on the results of the Classroom Action Research carried out in two cycles, it can be concluded that the use of the Papan Tempel Data media can improve second-grade students' mathematics learning outcomes on diagram topics at SDN Cipondoh 5. The improvement in learning outcomes is shown by the increase in the learning mastery percentage from 65.63% in Cycle I to 87.50% in Cycle II, which exceeds the established success indicator of at least 80% of students reaching the KKM. In addition, the use of the Papan Tempel Data media also increased student activity during the learning process. The percentage of student activity increased from 77% in Cycle I to 95% in Cycle II. This improvement shows that concrete and interactive media are able to encourage students' active involvement in grouping data, reading diagrams, interpreting information, and presenting data. The improvement in learning outcomes and student activity shows that the Papan Tempel Data media suits the developmental characteristics of second-grade elementary school students, who still need concrete learning experiences to understand mathematical concepts. Thus, the Papan Tempel Data media can be used as an effective alternative mathematics learning medium to help students understand diagram topics more meaningfully and to improve mathematics learning outcomes in elementary schools.

For teachers, it is recommended to use the Papan Tempel Data media in mathematics learning, especially on material related to the presentation of data in diagrams, because this medium can increase student involvement and make abstract concepts easier to understand. For schools, it is recommended to support the use of concrete and interactive learning media by providing facilities that support student-centered learning. For future researchers, it is recommended to develop the use of the Papan Tempel Data media on other mathematics topics or to examine its effect on other aspects of learning, such as learning motivation, critical thinking skills, and problem-solving skills, so that broader findings on the effectiveness of the medium can be obtained.



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