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The Influence of Scratch-Assisted Problem-Based Learning (PBL) Model on Improving Elementary School Students' Mathematical Understanding Ability

Neneng Dwi Fauziah, Puji Rahayu, Hafiziani Eka Putri*

PGSD Universitas Pendidikan Indonesia Kampus Purwakarta

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*Corresponding Author:
hafizianiekaputri@upi.edu

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ABSTRACT

This research is motivated by the low level of mathematical understanding among elementary school students. Mathematical understanding is crucial for students as it helps them interpret and solve both mathematical problems and everyday issues. The purpose of this study is to investigate the influence and effectiveness of the Problem-Based Learning (PBL) model, assisted by Scratch, on improving the mathematical understanding of elementary school students. The research method employed is a quasi-experiment using the Non-Equivalent Control Group Design. The sample consisted of 40 fifth-grade students from a state elementary school in a district of Purwakarta, with 20 students in class VA and 20 students in class VB. Class VA served as the experimental group, using the Problem-Based Learning (PBL) model assisted by Scratch, while class VB used conventional teaching methods. The results indicate that the PBL model, when assisted by Scratch, improved students mathematical understanding by 33.3%. Additionally, students who learned with the PBL model assisted by Scratch demonstrated better mathematical understanding compared to those who learned using conventional methods. Therefore, the PBL model can be considered an effective alternative for enhancing mathematical understanding skills.

INTRODUCTION

Mathematics is a crucial science that is deeply integrated into everyday life and is instrumental in solving daily problems. It is a mandatory subject in education. While mathematics is often taught in classrooms, its principles are also applied in daily activities (Utami & Wutsqa, 2017). Understanding mathematics is a vital skill that should be developed and emphasized in education. This understanding provides a foundation for solving problems, whether they are mathematical in nature or related to everyday situations (Asmara, Fitri & Faizah, 2022; Mulyani, Indah & Satria, 2018).

In fact, students' mathematical understanding in the field remains low. This issue arises because mathematics teachers are still unsure about the best learning methods to use. Additionally, students struggle to grasp the concept of integers, which impacts their understanding of addition and subtraction. Classroom learning often relies on traditional methods that do not actively engage students in the learning process (Nahdi & Alfiani, 2020; Herlina, Prapti, & Murni, 2019; Kurniati, 2022; Faizal, Nurlaela, & Herawati, 2022). Based on the research, it can be concluded that elementary school students' mathematical understanding is still inadequate. This low level of understanding is attributed to the lack of student engagement in the learning process, teachers' confusion about effective learning methods, and the persistence of traditional teaching practices.

In addition to using learning models, engaging learning media are also necessary. The media used must enhance students' enthusiasm for learning. Therefore, researchers have employed a website called Scratch. Scratch is a programming language that serves as an effective learning medium. This aligns with research by Ningrum & Novtiar (2023), who found that using Scratch media positively impacts students' mathematical understanding. Furthermore, Agung et al. (2023) demonstrated that Scratch enhances students' critical thinking skills. According to Bagasputera, Sundari, & Utami (2023), their research shows that Scratch improves student learning outcomes.

LITERATUR REVIEW

According to Sani (2015), Problem-Based Learning (PBL) involves presenting problems, asking questions, facilitating investigations, and encouraging dialogue. Bastian & Reswita (2022) describe PBL as a model that introduces authentic problems to students, enabling them to build their own knowledge, develop higher skills, become independent, and increase their self-confidence. This model uses contextual problems to help students develop problem-solving skills, allowing them to think critically both during learning and in everyday life (Lestari, 2020). Thus, the PBL learning model is designed to present real-world problems to students, who then work to find solutions. Through this approach, students can enhance their skills and knowledge while learning independently and confidently.

The purpose of Problem-Based Learning (PBL) is not only to impart knowledge to students but also to develop their critical thinking and problem-solving skills while actively engaging them in constructing their own understanding (Darwati & Purana, 2021). According to Masitoh (2021), PBL aims to enhance critical thinking skills and grasp the concepts behind the given problems, which subsequently impacts learning outcomes. Thus, the purpose of PBL is to train students' critical thinking, foster social skills, promote learning independence, and improve their ability to solve problems and understand the concepts they encounter.

Scratch is a platform that allows users to create projects without needing advanced programming skills (Sudihartinih, Novita, & Rachmatin, 2021). Pratiwi & Bernard (2021) describe Scratch as an accessible programming language that can be utilized as a learning medium for creating games, quizzes, animations, and more. Therefore, Scratch is a user-friendly programming language that serves as a versatile learning tool for developing interactive questions, stories, animations, and other educational materials. In this study, the Scratch website features resources such as learning videos and quizzes related to the topic of flat shapes.

According to Putriningsih & Sujadi (2021), mathematical understanding involves grasping concepts, principles, procedures, and the ability to apply problem-solving strategies, connect concepts to different problems, and expand these concepts to broader contexts. Sandri & Arafahnisa (2023) emphasize that mathematical understanding is crucial for learning mathematics effectively, as it enables students to comprehend, master, and apply existing concepts through problem-solving strategies. Therefore, mathematical understanding is the ability to grasp concepts, articulate material in one's own words, and apply this understanding to new problems.

Yudhanegara (in Pujiani, 2017) identified the following indicators of students' mathematical understanding: 1) Restating a concept; 2) Classifying objects based on their properties; 3) Identifying examples and non-examples of a concept; 4) Choosing and applying appropriate procedures or operations; 5) Using concepts or algorithms in problem-solving. In contrast, Sumarmo (in Amalia & Pratama, 2021) outlines broader indicators of mathematical understanding, including: 1) Knowing; 2) Understanding and applying concepts; 3) Procedures; 4) Mathematical principles and ideas. Zuliana (2017) describes additional indicators: 1) Restating a concept; 2) Classifying objects by their properties; 3) Providing examples and non-examples; 4)

Presenting concepts in various mathematical representations; 5) Developing conditions for the necessity or sufficiency of a concept; 6) Using and choosing various procedures or operations; 7) Applying problem-solving concepts or algorithms.

For this study, four indicators of mathematical understanding were adapted from Zuliana (2017) to align with the learning outcomes for fifth-grade mathematics, specifically concerning the circumference and area of flat shapes and their combinations. The selected indicators are: 1) Restating the concept; 2) Presenting concepts in various forms of mathematical representation; 3) Using and selecting appropriate procedures or operations; 4) Applying concepts or algorithms in problem-solving. These indicators are relevant to the learning outcomes in the independent curriculum phase C, which include: determining the circumference and area of various flat shapes and their combinations; constructing and analyzing spatial shapes and their combinations; recognizing spatial visualization; comparing characteristics between flat and spatial shapes; and determining locations on maps using a grid system

METHOD

This study employs a quantitative research approach with a quasi-experimental method. The research design used is the Non-Equivalent Control Group Design. The population for this study consists of all fifth-grade students in Purwakarta District for the 2024/2025 academic year. The research was conducted during the even semester of the 2024/2025 academic year at SDN 2 Babakancikao, Purwakarta. The study involved 40 fifth-grade students, with 20 students in Class VA and 20 students in Class B. Data collection occurred over 6 days, from June 14 to June 25, 2024. Data were gathered through tests to assess students' mathematical understanding and documentation in the form of photos of learning activities. To measure students' mathematical understanding, the researchers administered descriptive questions as tests before and after the treatment. The initial test, known as the pre-test, aimed to assess students' abilities before the intervention. The post-test, administered after the treatment, aimed to evaluate changes in mathematical understanding. The goal was to compare students' mathematical understanding before and after the intervention. After data collection, the researchers analyzed the pre-test and post-test results using the *Statistical Product and Service Solutions* (SPSS) application to determine the level of understanding in both the experimental and control groups.

RESULT AND DISCUSSION

In this research, the Scratch-assisted Problem-Based Learning (PBL) model was implemented to teach the material on the circumference and area of flat shapes and their combinations. This model was applied to the experimental class and demonstrated an influence of 33.3%, as indicated by the coefficient of determination. The Scratch-assisted PBL model, which incorporates indicators of mathematical understanding, proved more effective compared to conventional learning with a scientific approach. This effectiveness is attributed to the problem-based learning model's ability to actively engage students and encourage them to solve problems. Consequently, the use of the Scratch-assisted PBL model can enhance students' mathematical understanding skills. This finding aligns with previous research, which has shown that the PBL model positively impacts students' mathematical understanding (Supriatna, Wahyudin, & Turmudi, 2023; Nurhidayah, Mulyasari, & Riyanti, 2023). Therefore, it can be concluded that students' mathematical understanding improves when they are actively involved in learning, making the process more meaningful and effective.

The descriptive analysis of pretest scores revealed that the experimental class had an average score of 44.05, while the control class had an average score of 49.00. Both classes then received different treatments: the experimental class used the Scratch-assisted PBL model, and the control class used a conventional model. Following the treatments, the posttest scores

showed an average of 86.55 for the experimental class and 61.90 for the control class. The analysis indicates that the experimental class demonstrated a greater improvement in mathematical understanding compared to the control class after the intervention. This suggests that the Scratch-assisted PBL model was more effective in enhancing students' mathematical understanding than the conventional model, which employed a scientific approach. Independent t-test analysis of the posttest data further confirmed a significant difference in mathematical understanding between the two classes, indicating that the Scratch-assisted PBL model significantly improved students' mathematical abilities. Understanding is crucial as it underpins the learning process and adds meaning to the material being studied.

CONCLUSSIONS

Conclusion

Based on the research results presented in the previous chapter, the following conclusions can be drawn:

1. The Scratch-assisted Problem-Based Learning (PBL) model significantly influences students' mathematical understanding. The determination coefficient test shows that the Scratch-assisted PBL model accounts for 33.3% of the improvement in mathematical understanding, with the remaining 66.7% attributed to other factors. This indicates that the Scratch-assisted PBL model has a notable impact on enhancing students' mathematical understanding in elementary school.
2. Students who experienced the Scratch-assisted PBL model showed greater improvement in mathematical understanding compared to those who underwent conventional learning with a scientific approach.

Recommendation

Based on the research conducted using the Scratch-assisted Problem-Based Learning (PBL) model to enhance students' mathematical understanding, the following recommendations are made:

1. The research demonstrates that the Scratch-assisted PBL model significantly improves students' mathematical understanding. Therefore, it is recommended to adopt this model as an alternative learning approach to enhance mathematical skills.
2. The Scratch-assisted PBL model accounts for 33.3% of the improvement in mathematical understanding, with 66.7% attributable to other factors. Future research should investigate these other factors to better understand their impact on enhancing mathematical understanding.

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