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Improving Mathematical Problem-Solving Abilities Through An Open-Ended Approach In Grade VI Of Mi Maraqitta'limat Anyar In The 2025/2026 Academic Year

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Abstract

The purpose of this study was to improve the mathematical problem-solving skills of sixth-grade students at MI Maraqitta'limat Anyar using an open approach. The research approach used was CAR, which was conducted over two cycles. Participants in this study were 15 sixth-grade students from MI Maraqitta'limat Anyar. The tools used consisted of observation forms, problem-solving tests, and documentation. The results showed that the use of an open approach successfully improved students' abilities in solving mathematical problems. This improvement was reflected in the increase in students' test scores, rising from 20% in the pre-cycle to 46.7% in the first cycle, and reaching 80% in the second cycle. In short, the open method proved successful in encouraging students to engage in creative thinking and discover various strategies to solve problems

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1. INTRODUCTION

With its diverse languages, religions, and ethnic groups, Indonesia is the world's largest archipelagic country and a unitary republic. This diversity presents challenges in shaping a young generation with high character and moral principles, but it is also a national asset. The Indonesian education system must be able to develop human resources who are not only intellectually intelligent but also possess high moral standards, spirituality, and character to face increasingly rapid change. The preamble to the 1945 Constitution states that one of Indonesia's national goals is to educate its citizens. Educational efforts are crucial for informing the nation and fostering the development of the Indonesian population as a whole. The goal of education in Indonesia is to develop human potential.

Education is a crucial factor contributing to a nation's progress by enhancing the development of its human resources. Superior and effective education will undoubtedly equip individuals with the knowledge that will enable them to develop a strong understanding, abilities, and character (Sariani and Suarjana, 2022).

Education aims to cultivate the character of students so that they become better individuals. According to Law Number 20 of 2003 concerning the National Education System, Chapter 1, Article 1, Paragraph 1, states: "Education is a deliberate and organized effort to cultivate an environment and learning process, which enables students to actively improve their ability to develop spiritual and religious strength, self-regulation, personality, intelligence, commendable values, and competencies needed for themselves, society, nation, and state." (Hesti Yulianti et al., 2018) Mathematics is one of the subjects that continues to be taught at all levels of education.

To achieve optimal learning outcomes, improving the quality of education is crucial. Therefore, various strategies are adopted to create engaging, imaginative, and innovative learning experiences that align with contemporary advances and technology (Aonilah, 2022).

Recently, the use of open-ended questions in mathematics teaching has gained popularity in educational discussions due to their ability to enhance students' higher-order thinking skills, particularly in problem-solving and creative reasoning (Ariani et al., 2014; Ramadhani et al., 2020). Unlike closed-ended questions, which have only one correct answer, open-ended questions allow students to explore various solution methods and generate more than one acceptable answer.

The open-ended problem-solving method in mathematics education involves presenting questions or tasks with multiple correct answers and allowing for a variety of solution strategies. This technique allows students to share their thoughts, thought processes, and approaches to problem-solving based on their unique abilities and knowledge. The primary goal of this method is not to achieve a single outcome, but to enhance students' mathematical thinking, which includes reasoning, creativity, and communication skills as they explore multiple solutions (Ruseffendi, 2006; Shimada, 1997).

Through this methodology, students can improve their problem-solving and creative thinking skills, as they are encouraged to consider multiple possibilities and reflect deeply on their answers (Ermawati and Zuliana, 2020; Pamungkas and Kowiyah, 2021). Bayarcal et al. (2023) highlight that open-ended problems can foster an environment where students can freely share their ideas and deepen their mathematical understanding through thoughtful and adaptive thinking.

The significance of this approach is all the more significant given recent international assessment findings. The 2022 Programme for International Student Assessment (PISA) showed that Indonesian students performed significantly below the OECD average in mathematical literacy (OECD, 2023). Only about 18% of Indonesian students reached level 2, which represents the basic ability to model real-world problems mathematically, and less than 1% reached the highest levels (levels 5 and 6), which demonstrate the ability to model, analyze, and solve complex problems (OECD, 2023a). Furthermore, for the first time, PISA also assessed proficiency.

Creative thinking skills are still lacking in Indonesia, which has the lowest level in the world, with only 5% of students indicating that they can generate and develop new and useful ideas (OECD, 2023b). A similar problem was seen in the Trends in International Mathematics and Science Study (TIMSS), which found that Indonesian students face challenges in solving non-routine mathematics problems that require adaptive strategies and flexible thinking (Mullis et al., 2016). These results underscore the importance of learning methods that go beyond...

Most teachers today emphasize memorizing math formulas, calculating skills, and final answers, with the primary focus being on the teacher. As a result, students are often given numerous math formulas to memorize, leading them to memorize without truly understanding the concepts. This leads to students relying heavily on rote learning. Students must develop their own thinking skills.

This reflects Ruseffendi's (1991: 156) assertion that mathematics is about understanding through reasoning, not just memorization. Consequently, when asked to solve math problems, students often struggle with similar types of problems. This indicates that they have not yet developed a solid understanding of the concepts, but instead rely solely on memorized answers.

Observations on problem-solving skills indicate that they are crucial for mathematics education in elementary schools, especially for sixth-grade students. In this grade, students should be able to solve problems independently. Success in solving problems will enable them to tackle open-ended problems later in life. However, many students still struggle to solve math problems independently. Research conducted at MI Maraqitta'limat Anyar showed that many sixth-grade students struggled with problem-solving, as evidenced by only 20% completing assignments, and many receiving scores below the Minimum Competency (KKM). This indicates that out of 15 students, only 3 were able to complete their problem-solving assignments. The challenges faced were often caused by a lack of overall mathematical understanding, a lack of mastery of basic

concepts, a lack of practice, and ineffective teaching methods. Furthermore, there was a lack of interest and motivation among students, particularly with the open-ended learning approach, but research on its effectiveness at MI Maraqitta'limat Anyar in improving sixth-grade students' problem-solving abilities is still limited. Therefore, this study aims to improve students' problem-solving abilities at MI Maraqitta'limat Anyar. Furthermore, teachers need to be more innovative in creating learning strategies that can actively involve students, such as by incorporating open learning methods.

2. RESEARCH METHODS

This research uses a Classroom Action Research (CAR) approach. Classroom Action Research (CAR) is an investigative method conducted by teachers in the classroom to improve and strengthen the quality of learning experiences and their outcomes. CAR is conducted through a series of planned actions, where each action is assessed to determine its strengths and weaknesses, which serve as a basis for improvement in the next cycle.

The Kemmis and McTaggart model, which includes four stages—planning, action, observation, and reflection—is the CAR model used in this study. These four phases are carried out sequentially and in several cycles until the predetermined success criteria are met.

This research was conducted in the even semester of the 2025/2026 academic year at MI Maraqitta'limat Anyar. Fifteen sixth-grade students from MI Maraqitta'limat Anyar formed study groups.

This study aimed to assess students' mathematical problem-solving abilities through the use of open methodology.

In this study, data were collected using interviews, tests, documentation, and observations. Observations were conducted to monitor teacher and student behavior during the learning process. At each cycle, tests were administered to measure improvements in students' mathematical problem-solving abilities. Interviews were conducted to learn more about how students reacted to their education, and documentation was used to supplement the research data.

This study was conducted over two cycles, each consisting of two meetings. The results of each cycle were examined to determine whether there was improvement in students' mathematical problem-solving skills and to inform improvements in the next cycle.

3. RESULTS AND DISCUSSION

Pre Cycle

The pre-cycle phase was conducted to determine the initial condition of the sixth-grade students' mathematical problem-solving abilities at MI Maraqitta'limat Anyar before implementing an open-ended approach in the learning process. The pre-cycle activities began with observations of the mathematics learning process taking place in the classroom and administering an initial test to the students.

Based on observations, the mathematics learning process is still dominated by lectures and examples provided by teachers. Students tend to simply follow the steps shown without attempting to find alternative solutions. Student engagement in learning remains low, as evidenced by the lack of students asking questions, offering opinions, or discussing problems with their peers. Furthermore, students focus more on memorizing formulas than understanding concepts and problem-solving processes.

When teachers assign story problems or problem-solving tasks, most students struggle to understand the problem's purpose, determine a solution strategy, and systematically write down the steps. Students also lack confidence in presenting different ideas or answers because they're accustomed to thinking that every problem has only one correct answer and one solution.

To determine students' initial abilities, researchers administered a pre-cycle test in the form of mathematical problem-solving questions. The test results indicated that students' mathematical problem-solving abilities were still relatively low. Of the 15 students, only 3 achieved the minimum passing grade (KKM), while 12 students scored below the KKM. These low learning

outcomes indicate that students' abilities in understanding problems, planning solutions, implementing strategies, and reviewing answers still need improvement.

Based on the results of these observations and initial tests, a learning approach is needed that can actively engage students, encourage creative thinking, and provide opportunities for students to find various alternative solutions to problems. Therefore, the researchers implemented an open-ended approach as an effort to improve the mathematical problem-solving skills of sixth-grade students at MI Maraqitta'limat Anyar.

Cycle I

Planning stage

Teachers create lesson plans using open-ended methods during the planning phase of cycle I. Designing learning activities that allow students to explore various problem-solving methods, selecting materials, and setting learning objectives are the main focus of the planning. Open-ended methods are intended to foster creative and flexible mathematical problem-solving skills in students because they are not limited to a single solution or approach (Ruseffendi, 1991). In addition, teachers design evaluation questions that are in accordance with indicators of students' mathematical problem-solving abilities, as well as worksheets for students and observation tools for both teachers and students.

Implementation Stage

Actions in cycle I were implemented according to the established plan. The teacher began the lesson by introducing a contextual problem with an open-ended conclusion, giving students the freedom to develop various solutions to the problem. The instructor acted as a facilitator throughout the learning process, helping students understand the problem, develop a solution plan, and express their thoughts. The open-ended method encouraged students to actively participate in discussions, ask questions, and voice their thoughts. This supports Bruner's thesis that learning will be more meaningful if students are actively involved in the process of acquiring knowledge (Bruner, 2010).

Observation Stage

Researchers observed instructors and students engaging in their learning process throughout the observation period. Lesson plans were used as a guide to determine how well the learning was implemented, and student responses to the implementation of the open-ended approach were observed. Some students, according to observations, began to actively participate in discussions and attempted to use various problem-solving techniques. However, some students were passive and lacked confidence in voicing their thoughts. Students were still adjusting to a learning style that requires active and independent thinking, as seen in this scenario.

Reflection Level

According to data collected during Cycle I observations and assessments, the open approach increased students' capacity for mathematical problem solving compared to the pre-cycle period. The evaluation results in cycle I showed that 4 students, or 26.7%, met above the KKM, so the total number who had met above the KKM was 7 students, or 46.7%. However, this result is still far from the goal set for classical completion. Students' continued dependence on teacher instructions and their failure to practice articulating their own thoughts are some of the problems we faced. Consequently, it is crucial that cycle II learning be improved by increasing the level of discussion and offering more focused guidance, so that students are more engaged and confident.

Cycle II

Planning Stage

During the planning phase of the second cycle, educators create updated lesson plans utilizing insights gained from the reflections from the first cycle. These modifications aim to increase student engagement, offer more structured support, and deepen understanding of mathematical problem-solving concepts. Teachers design a variety of learning activities and construct open-ended questions that are appropriate in complexity to the students' ability levels. The goal of this planning is to help students gain a thorough understanding of the problem and

confidently articulate their own solutions, adhering to the educational principle that prioritizes the learner's cognitive processes (Ruseffendi, 1991).

Actions taken in the second cycle were implemented according to the revised plan. The instructor provided more explicit guidance on the steps to solve the problem, facilitated more focused group discussions, and encouraged active participation from all students. Throughout the learning experience, students were given greater opportunities to express their thinking, compare various problem-solving strategies, and collaboratively draw conclusions. This educational approach, which recognizes students as proactive participants, aligns with Bruner's perspective, which highlights the importance of student engagement in constructing their own knowledge (Bruner, 2007).

In Cycle II, observations were conducted to evaluate the learning process and student engagement. The results showed increased student participation and confidence during the lesson. The majority of students demonstrated a strong understanding of the problem, formulated solution strategies, and were able to communicate their reasoning to the class. Furthermore, student interactions during group discussions were more productive than in Cycle I.

From the results of observations and assessments conducted in Cycle II, it is clear that the implementation of the open approach resulted in 5 students (33%) who were above the KKM so that in this second cycle, those who had succeeded above the KKM were 12 very good results. The evaluation showed that 12 out of 15 students met the minimum criteria for completion, resulting in an overall success rate of 80% in learning. This progress shows that the improvements made in Cycle II effectively addressed the challenges faced in Cycle I. Therefore, the implementation of the open approach succeeded in improving the mathematical problem-solving abilities of sixth-grade students at MI Maraqitta'limat Anyar.

Inter Cycle

Research findings from the pre-cycle, cycle I, and cycle II show a steady and sustained improvement in students' mathematical problem-solving abilities. During the pre-cycle phase, student learning performance remained quite poor, highlighting the need for improved teaching methods. After the open approach was implemented in cycle I, students' mathematical problem-solving abilities began to improve, although the results were still unsatisfactory.

Reflections from Cycle I helped shape instructional changes for Cycle II. These adjustments led to greater student engagement, increased self-confidence, and improved ability to understand and solve mathematical problems. The significant increase in learning success in Cycle II indicates that the process of improving learning between cycles was effective and successful.

4. DISCUSSION

Based on the findings from observations and assessments in Cycle II, it was determined that the use of an open approach produced the best results. The assessment results showed that 12 of the 15 students met the minimum requirements for completion, resulting in a classical learning completion rate of 80%. This improvement indicates that the learning enhancements implemented in Cycle II effectively addressed the challenges encountered in Cycle I. Therefore, the use of an open method proved successful in improving the mathematical problem-solving skills of sixth-grade students at MI Maraqitta'limat Anyar. This indicates that the use of an open approach successfully improved the mathematical problem-solving skills of sixth-grade students at MI Maraqitta'limat Anyar. This growth was evident in the test results, which showed consistent improvement at each stage of the process. In the pre-cycle conditions, students' classical completion rate was only 60%. This is because students often focus on a single answer or have difficulty understanding basic mathematical concepts, which makes solving problems presented in a slightly different format challenging. This situation reflects a traditional educational approach that emphasizes memorization, mathematical skills, and final results. However, mathematics involves understanding that relies on logical reasoning rather than memorization (Ruseffendi, 1991: 156).

After the Open-Ended approach was implemented, there was a significant change in student learning behavior. In Cycle I, although classical completeness increased to **60%**, there were still weaknesses, namely that students were less accustomed to flexible thinking, and discussions were not evenly distributed, and some students only found 1-2 solutions. Dramatic improvements continued in Cycle II, where classical completion reached the target 80%. At this stage, students appear more active, creative, and able to find various solutions and use more varied methods/strategies.

Numerous educational studies support the conclusion that students are encouraged to learn various problem-solving strategies through open-ended approaches. Nohda (2000) stated that this strategy helps students develop their creativity and flexibility of thought. Open-ended questions encourage deeper thinking about solutions by providing greater scope for exploration (Ermawati & Zuliana, 2020; Pamungkas & Kowiyah, 2021). Bayarcal et al. (2023) also highlighted that open-ended questions provide students with more opportunities to express their ideas and gain a greater understanding of mathematics.

In addition, the improvements seen in Cycle II, particularly in strategic planning skills, using different methods, and drawing conclusions, indicate that learning has become more meaningful. This supports the view of Bruner (2010), which states that meaningful learning occurs when students discover concepts through a process of exploration. This process is in line with the problem-solving framework proposed by Polya (1973), which requires a step-by-step thinking process that must be practiced. Overall, improvements in activeness, independence, and communication skills were also observed, making it a solution to overcome students' difficulties with non-routine and contextual mathematics problems.

The significance of these results becomes clearer when considered within a national and global framework. Indonesian students demonstrate low problem-solving and creative thinking abilities in international assessments, such as the 2022 Program for International Student Assessment (PISA), where their mathematical literacy and innovative thinking levels significantly lag behind the OECD average (OECD, 2023a; OECD, 2023b). This situation demands a transformation in educational methods. The Open-Ended Approach has proven effective in addressing this issue by equipping students with the skills to create and refine ideas in unique and effective ways, which are crucial for developing higher-order thinking skills (Ramadhani et al., 2020).

5. CONCLUSION

Conclusion

Based on findings from two cycles of CAR, it was found that the use of open-ended learning methods helped sixth-grade students at MI Maraqitta'limat Anyar improve their math problem-solving skills. This success was demonstrated by significant improvements in learning outcomes, with the percentage of students completing their assignments increasing from 20% in the pre-cycle to 26.7% in the first cycle, and 33% in the second cycle, for an overall improvement of 80%. This significant increase demonstrates that the open-ended approach effectively motivates students to think in new and flexible ways as they discover and develop various strategies for solving problems. In addition to the visible improvement in learning outcomes, this method also positively impacted students' participation, independence, and communication skills during learning.

Based on these findings, it is recommended that teachers regularly use an open-ended approach when teaching mathematics, especially for topics that involve exploring ways to solve problems. Teachers should help students feel comfortable with problems that have multiple possible solutions and encourage them to share diverse ideas and strategies without fear. Furthermore, it is important to present a variety of solution examples early in the learning process and provide more guidance (mentoring) to students who are shy or have difficulty starting to plan their strategies, similar to the approach in Cycle II. Schools are advised to support and facilitate workshops or discussions among teachers on how to apply creative learning methods, particularly

open-ended approaches, to address the problem of weak problem-solving and creative thinking skills in students. Finally, future researchers are encouraged to conduct more studies that focus on specific areas, such as how open-ended methods affect critical thinking skills or mathematical problem-modeling skills, across grade levels or subjects.

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