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THE USE OF GEOBOARD MANIPULATIVE TO IMPROVE ELEMENTARY SCHOOL STUDENT MATHEMATICAL PROBLEM-SOLVING SKILLS: A CLASSROOM ACTION RESEARCH

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ABSTRACT

Fourth-grade students at SD Negeri 1 Pejambon showed low mathematical problem-solving skills in learning plane geometry. This condition was associated with the limited use of teaching aids, insufficient opportunities for students to construct plane shapes independently, and a lack of concrete problem-solving activities during instruction. This study aimed to describe the planning, implementation, and outcomes of using geoboard teaching aids to improve students' mathematical problem-solving ability. The method used was Classroom Action Research (CAR) following the Kemmis and Taggart model, consisting of planning, action, observation, and reflection, conducted over two cycles involving 20 fourth-grade students. Data were collected through observation sheets (covering the teaching module, teacher performance, affective aspects, and psychomotor problem-solving skills) and essay-based tests, the analyzed using both quantitative and qualitative methods. The result showed consistent improvement across Cycles: the lesson-planning score increased from 44.44% (Pre-Cycle) to 77.77% (Cycle I) and 88.88% (Cycle II); teacher performance improved from 57.14% to 71.42% and reached 100% in Cycle II; students' affective ability rose from 10% to 30%, with 90% of students reaching the "good" category in Cycles II; problem-solving (psychomotor) ability increased from 0% to 30% and reached 85% in Cycle II; and learning outcome mastery rose from 0% to 30% and reached 75% in Cycle II, meeting the study's success indicator. These findings indicate that the use of geoboard teaching aids contributed to improving fourth-grade students' mathematical problem-solving ability on the topic of plane geometry topics. This study also highlights the educational value of geoboard as concrete learning media that support elementary students in understanding geometric concepts and developing problem-solving skills.

Keywords: Geoboard Manipulative Media, Mathematical Problem-Solving Skills, Classroom Action Research, Geometry, Elementary School.

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PRELIMINARY

Matematics learning in elementary school plays a fundamental role in developing students' logical thinking, conceptual understanding, and mathematical problem solving skills. Elementary school education is a form of formal education aimed at developing basic skills and abilities to prepare students for further education (Syamsiyah et al., 2023).

Learning in elementary school essentially emphasizes concrete, guided, and comprehensive learning experiences so that all students can understand basic concepts more easily and meaningfully.

According to Fitriani (2016), the learning process in elementary school mathematics, which involves the study of abstract numerical concepts, plays a very important role in the development of students' thinking patterns (Juwita et al., 2025). Students ways of thinking are influenced by the characteristics of mathematics content, which includes basic concepts, patterns, structures, and mathematical relationships between various objects and phenomena. It is not uncommon for the material taught to require students to visualize it abstractly (Selviana et al., 2024).

According to Ramadianti (2021), elementary school students are in the concrete operational stage of learning, meaning that their learning process ideally involves real objects or events relevants to their daily lives (Hidayat et al., 2025). At certain ages, this becomes a serious problem and ultimately hinders students from mastering the material and prevents them from fully developing their skills tanging from comprehension, reasoning, and analysis to the application of the knowledge they have acquired. Yet these skills are essential for students to develop proficiency in mathematical problem-solving (Sari et al., 2019).

According to (Sheptia et al., 2026), problem-solving skills are the abilities that students possess to address problems, ranging from understanding the core of the problem, devising the methods or strategies needed to solve it, to implementing those strategies (Widyastuti & Airlanda, 2021). According to Saryantono (2013), problem-solving skills are students ability to apply their prior knowledge to new situations they have never encountered before (Sulistyani et al., 2020). Similary, Surya (2013), problem-solving skills refer to students ability to understand a problem by identifying known and unknown elements and determining which elements are necessary, devising or formulating solution strategies and presenting them, selecting or applying strategies to arrive at a solution, and verifying the correctness of the solution and interpreting it (Amam, 2017).

Problem-solving skills are essential for students to deal with the challenges they face in life, with the hope that they will be equipped to solve problems in their daily lives. (Kharisma & Asman, 2018). In elementary mathematics learning, these skills enable students to understand mathematical concepts, apply appropriate strategies, and solve mathematical problem systematically. Therefore, developing mathematical problem-solving

skills is one of the important objectives of mathematics learning in elementary school (Kemendikbud, 2022).

To improve students mathematical problem-solving skills, it is necessary to use innovative teaching aids that directly engage students in the learning process. One such tool is the geoboard. Manipulative are a set of cocrete objects that are intentionally created, designed, collected, or arranged to help instill or develop mathematical concepts (Mulianingtias et al., 2024).

According to Polya, there are 4 indicators of problem-solving ability are as follows, understanding the problem involves identifying the known and unknown information as well as determining the information needed to solve the problem, formulating a solution plan refers to selecting an appropriate strategy or mathematical formula to obtain the correct solution, implementing the problem-solving plan involves applying the selected strategy and performing the necessary calculations accurately, and double checking requires students to review their solution and verying the correctness of the final answer. (Gumanti et al., 2022). The factors affecting problem-solving skills are as follows, prior knowledge, appreciation of mathematics, and logical intelligence (Irawan et al., 2016).

Teaching aids are anything that can be used and utilized to explain learning concepts, particularly those that are abstract or unclear, in a way that makes them tangible and clear, there by stimulating the minds, emotions, attention, and interest of students, which in turn facilitates the teaching learning process (Mutiara et al., 2024)

A geoboard is a geometry board created and popularized by the Egyptian mathematician Caleb Gattegno (1911 – 1988) as a versatile tool for teaching geometry (Sibiya et al., 2025). According to Sibiya and Mudaly (2018), geoboard is a tool designed for use in the teaching and learning process across various areas of mathematics in the classroom, as students find it easier to understand geomentry through the use of a geoboard (Sopian et al., 2020).

Figure 1. Geoboard Manipulative Media

According to Firdaus (2025), a geoboard is a highly useful visual tool in the learning process, especially when teaching abstract geometric concepts. A geoboard is a tool that aids in teaching geometric concepts, such as plane figures, calculating the perimeter of plane figures, and determining the area of plane figures (Ali et al., 2025).

Therefore, it can be concluded that the geoboard is a concrete teaching aid designed to help students understand and develop abstract concepts by making them more tangible through hands-on experience.

According to Winasis (2012), the benefits of geoboard as teaching aids are as follows, geoboard have several adventages as teaching aids: they are with a simple design, so they do not require much time or effort, they are economical because they can be used repeatedly at a relatively low cost, The materials and tools needed to make them are readily available, and they incorporate engaging game elements that can increase children's interest in the learning process. The implementation of geoboard manipulative begin by allowing students to become familiar with the tool. The teacher then explains how to use the rubber bands correctly before. After that, students use the rubber bands to construct two-dimensional geometric shapes on the geoboard based on the instructions or problem provided (Bondhowati et al., 2024).

Geoboard have several adventages, they can foaster students interest in learning bt making lessons more engaging, clarify the meaning of the subject matter so that students do not easily become bored, and encourage students to be more active in learning activities through observing, experimenting, practicing, and demonstrating the concepts they are studying (Zildjianshi et al., 2022a).

Based on the result of preliminary observations conducted in the fourth-grades calss at SD Negeri 1 Pejambon in Sumber Subdistrict, Cirebon Regency, students mathematical problem-solving skills remain low. This is because instruction has not yet incorporated

visual aids, lessons do not provide sufficient opportunities for students to construct two-dimensional shapes independently, and instruction does not adequately facilitate the search for concrete solutions. As a result, students have difficulty understanding problems, formulating solution strategies, implementing those strategies, and verifying their work regarding geometric elements (plane figure).

Based on the problem identified, this study addresses the following research questions:

1. How can the use of geoboard manipulative media be planned to improve the mathematical problem-solving skills of fourth grade students at SD Negeri 1 Pejambon?
2. How is the implementation of geoboard manipulative media carried out to improve students' mathematical problem-solving skills of fourth grade students at SD Negeri 1 Pejambon?
3. How does the use of geoboard manipulative media improve the mathematical problem-solving skills of fourth grade students at SD Negeri 1 Pejambon?

Based on the research question above, the objectives of this study are to:

1. To determine how to plan the use of geoboard to improve the mathematical problem-solving skills of fourth grade students at SD Negeri 1 Pejambon.
2. To determine the implementation of geoboard to improve the mathematical problem-solving skills of fourth grade students at SD Negeri 1 Pejambon.
3. To determine the mathematical problem-solving skills of fourth grade students at SD Negeri 1 Pejambon after using the geoboard teaching aid.

METHODS

The study was conducted using the Classroom Action Research (CAR) method. This study places greater emphasis on the research process or action. Therefore, the success or failure of the study can be assessed based on the research process. The research model used in this classroom action reseach is the Kemmis and Taggart cycle model, which consists of four components: planning, action, observation, and reflection (Dahlani, 2019). The study was conducted in the fourth-grade class at SD Negeri 1 Pejambon in Sumber Subdistrict, Cirebon Regency, during the second semester of the 2025/2026 school year. The participants consisted of 20 students (10 boys and 10 girls), aged 9-10 years. The participants were selected using purposive sampling. The fourth-grade was chosen because the students experienced difficulties in learning geometry and mathematical prombelm-solving, making it suitable for implementing the classroom action research.

This study used observation and test instruments. The observation instruments included observation sheets for the teaching module, teacher performance, students' affective behaviour, and mathematical problem-solving skills. These instruments were developed based on the research indicators and validated by experts before use. The test instrument consisted of three open-ended questions design to assess students' mathematical problem-solving skills. Students' responses assessed using Poly's problem-solving stages of understand the problems, formulating a solution plan, implementing the problem solving plan, and double checking their answer. The test was administered as a posttest.

The data were analyzed using quantitative and qualitative methods. Quantitative data from the posttest were analyzed by calculating the mean score and the percentage of students who achieved the minimum Learning Objective Achivement Criteria in each cycle. Quantitative data obtained from classroom observations were analyzed through data reduction, data display, and conclusion drawing to evaluate the implementation of the learning process and students' mathematical problem-solving skills (Qomaruddin & Sa'diyah, 2024).

Success indicators are determined based on the research objectives and include indicators of the learning process and students problem-solving skills. At the elementary school level, success indicators are determined based on the increase in the percentage of students problem-solving skills as a class following the implementation of geoboard in mathematics instruction. The success criterion was established when at least 75% mathematical problem-solving skills. This criterion was adopted based on the success standard commonly used in Classroom Action Research. The primary success indicator of this study was the improvement of students' mathematical problem-solving skills. Learning process indicators, including students active engagement, responsibility, cooperation, and independence, were used only as supporting observational data to evalute the implementation of the learning process and were not considered the primary criteria for determining the success of the intervention. In each action cycle, the teacher demonstrated the use of the geoboard to explore plane geometry concepts and solve mathematical problems. Students practiced using the geoboard through individual and group activities, followed by class discussions, reflection, and a posttest. The result of each cycle were used to improve the implementation of the subsequent cycle.

RESULT AND DISCUSSION

The Pre-Cycle was held on Monday, May 11, 2026, in the fourth-grade classroom at SD Negeri 1 Pejambon, without the use of geoboard, as the baseline condition prior to the intervention. The result showed that performance remained low across all observed aspects.

During the Pre-Cycle stage, instruction was still conducted without the use of geoboard, so the student mathematical problem-solving skills remained low. Observations results showed that the teaching module received a score of 12 (44.44%) in the "sufficient" category, while the teacher performance received a score of 12 (57.14%) in the "sufficient" category. Students affective aspects were also still low, with only 2 students (10%) falling into the "good" category. Mathematics problem-solving skills have not yet met the success indicators, as no students (0%) were categorized as "good". Similary, the learning outcomes show that 0 students (0%) achieved mastery, while 20 students (100%) did not. These findings indicate that students experienced difficulties in understanding plane geometry concepts and applying mathematical problem-solving strategies during the pre-cycle. Since the learning process was conducted without the use of the geoboard, students had limited opportunities to visualize geometric concepts through concrete learning experiences. Consequently, their mathematical problem-solving skills and learning outcomes remained low. These findings support constuctivist learning theory, which emphasizes that students develop conceptual understanding through direct interaction with concrete learning media. Based on these results, reflection indicated that the learning process still has many shortcomings, including in the development of teaching module, teacher performance, affective aspects, problem-solving skills, and students learning outcomes. Therefore, improvements need to be made in Cycle 1 through the use of geoboard to make learning more affective.

In Cycle 1, the use of geoboard began to have a positive impact on the learning process. The teaching module received a score of 21 (77.77%) falling into the "good" category, while teacher performance improved to 15 (71.42%), also in the "good" category. Students affective aspects also improved, with 6 students (30%) falling into the "good" category. Mathematical problem-solving skills improved, with 6 students (30%) achieving the "good" category. Although there was a improvement compared to the Pre-Cycle, these results have not yet met the research success indicators. The improvement can be explained by the use of the geoboard as a concrete manipulative that enabled students to visualize abstract plane geometry concepts.

By constructing and exploring geometric shapes directly, students were better able to identify problem situations, develop solution strategies, implement their plans, and double checking their answers in accordance with Polya's problem-solving stages. This finding is consistent with constructivies learning theory, which emphasizes that meaningful understanding develops through active interaction with concrete learning media. Based on reflection, there are still several indicators including teaching module, teacher performance, affective aspects, problem-solving skills, and learning outcomes. That have not yet reached their targets. Reflection on Cycle I showed that some students still had difficulty using the geoboard and applying problem-solving strategies. This occurred because students had limited prior experience with manipulative media and still required guidance during learning activities. Therefore, in Cycle 2 are clearer instruction, more intensive teacher guidance, and additional practice opportunities to help students use the geoboard more confidently and improve their problem-solving skills.

In Cycle 2, the research results showed significant improvements in all aspects. The teaching module received a score of 24 (88.88%), placing them in the "very good" category, while teacher performance reached 21 (100%). The students affective aspects improved, with 18 students (90%) falling into the "good" category, while their mathematical problem-solving skills improved, with 17 students (85%) achieving the "good" category. The learning outcomes also showed that 15 students (75%) had achieved mastery, meaning the class-wide mastery target was successfully met. These findings indicate that the use of the geoboard not only improved students' learning outcomes but also enhanced their understanding of plane geometry and mathematical problem-solving skills. Through hands-on exploration, students became more active in identifying problems, developing solution strategies, and double checking their answers, resulting in more meaningful learning. Based on the results of the reflection, most of the teaching module indicators have been met, and teacher performance, affective aspects, problem-solving skills, and student learning outcomes have achieved the research success targets. Therefore, the interventions in Cycle 2 are deemed successful, and the research does not need to proceed to the next Cycle. These findings indicate that geoboard can serve as an effective learning medium for teaching plane geometry in elementary schools by promoting active learning and improving students' mathematical problem-solving skills.

The use of geoboard to improve fourth-grade students mathematical problem-solving skills showed improvement. In the Pre-Cycle, the number of students who met the criteria for mastery was 0 students (0%), in Cycle 1, the number was 6 students (30%), and in Cycle

2, the number was 17 students (85%). For further details, a summary of the implementation results (observation of students mathematical problem-solving skills) can be seen in Table 1 below:

Table 1. Summary of Implementation Result (Observation of Students Mathematical Problem-Solving Skills)

Cycle	Completed	Incomplete
Pre-Cycle	0 Students (0%)	20 Students (100%)
Cycle 1	6 Students (30%)	14 Students (70%)
Cycle 2	17 Students (85%)	3 Students (15%)

Based on Table 1 above, the summary of the implementation results (observation of students mathematical problem-solving skills) showed an increase. From the Pre-Cycle to Cycle 1, there was a 30% increase. From Cycle 1 to Cycle 2, there was a 55% increase. This is because Cycles 1 and 2 involve the following aspects understanding the problem, developing a solution plan, and checking the result which are practiced through the use of geoboard.

This indicates that the use of geoboard is an effective teaching aid for improving students mathematical problem-solving skills. It stimulates students to think critically, discover concepts, solve problems systematically, and enhance their understanding of plane geometry concepts.

The use of geoboard to improve fourth-grade students mathematical problem-solving skills showed improvement. In the Pre-Cycle, 0 student (100%) met the learning objectives, in Cycle 1, 6 students (30%) met the learning objectives, and in Cycle 2, 15 students (75%) met the learning objectives. For further details, a summary of the implementation results (students learning outcomes) can be seen in Table 2 below:

Table 2. Summary of Implementation Result (Students Learning Outcomes)

Cycle	Completed	Incomplete
Pre-Cycle	0 Students (0%)	20 Students (100%)
Cycle 1	6 Students (30%)	14 Students (70%)
Cycle 2	15 Students (75%)	5 Students (25%)

Based on Table 2 above, summary of the implementation results (students learning outcomes) showed an increase. From the Pre-Cycle to Cycle 1, there was a 30% increase. From cycle 1 to Cycle 2, there was a 45% increase.

The results of the study indicate that geoboard have significant potential to improve the quality of learning. The use of geoboard not only affects teacher performance but also impacts teaching modules, students affective responses, their problem-olving skills, and

their learning outcomes. These findings are consistent with Muf'afidah and Putra (2023), who reported that geoboard assistes learning improved elementary students' mathematical problem-solving skills. The use of geoboard helps students visualize geometric concepts more concretely, maing it easier for them to understand concepts and solve mathematical problems.

The use of geoboard to improve fourth-grade students mathematical problem-solving skills showed improvement. In the Pre-Cycle, the score was 12 (44.44), in Cycle 1 the score was 21 (77.77%), and in Cycle 2, the score was 24 (88.88%). For more details, a summary of the planning results (teaching module) can be seen in Table 3 below:

Table 3. Summary of Planning Result (Teaching Module)

Cycle	Total Score	Precentage (%)
Pre-Cycle	12	44.44%
Cycle 1	21	77.77%
Cycle 2	24	88.88%

Based on Table 3, the summary of planning results (teaching module) showed an increase. From the Pre-Cycle to Cycle 1, there was a 33.33% increase. From Cycle 1 to Cycle 2, there was an increase of 11.11%. This improvement can be at attributed to the integration of geoboard as a concrete learning medium, which helped students visualize mathematical concepts and actively construct their understanding, consistent with constructivist learning theory. This is because the lesson plans for Cycles 1 and 2 included the use of geoboard as teaching aids. This improvement may be attributed to the use of geoboard as a concrete learning medium, which enhanced students' understanding of mathematical concepts and promoted active learning, consistent with the findings of Zildjianshi (2022).

The use of geoboard to improve fourth-grade students mathematical problem-solving skills showed improvement. In the Pre-Cycle, the score was 12 (57.14%), in Cycle 1 the score was 15 (71.42%), and in Cycle 2 the score was 21 (100%). For more details, a summary of the implementation result (teacher performance) can be seen in Table 4 below:

Table 4. Summary of Implementation Result (Teacher Perfomance)

Cycle	Total Score	Precentage (%)
Pre-Cycle	12	57,14%
Cycle 1	15	71,42%
Cycle 2	21	100%

Based on Table 4 above, the summary of implementation result (teacher performance) showed an increase. From the per-Cycle to Cycle 1, there was a 14.28% increase. From Cycle 1 to Cycle 2, there was a 28.58% increase. This is because, during the

implementation of Cycles 1 and 2, the use of geoboard wasoptimized, making it easier for teachers to explain the concepts of two-dimensional shapes, manage the classroom, motivate students, and actively engage them in the learning process.

The use of geoboard to improve fourth-grade students mathematical problem-solving skills showed improvement. In the Pre-Cycle, the number of students who met the criteria for mastery was 2 students (10%), in Cycle 1, the number was 6 students (30%), and in Cycle 2, the number was 18 students (90%). For further details, a summary of the implementation results (affective observations of students) can be seen in Table 5 below:

Table 5. Summary of Implementation Result (Affective Observations of Students)

Cycle	Completed	Incomplete
Pre-Cycle	2 Students (10%)	18 Students (90%)
Cycle 1	6 Students (30%)	14 Students (70%)
Cycle 2	18 Students (90%)	2 Students (10%)

Based on Table 5 above, the summary of implementation result (students affective observations) showed an increase. From the Pre-Cycle to Cycle 1, there was a 20% increase. From Cycle 1 ro Cycle 2, there was a 60% increase. This is because, during the implementation of Cycle 1 and Cycle 2, aspects of critical thinking, creativity, and independence were developed through the use of geoboard in both group and individual learning activities.

The improvement in students' learning outcomes indicates that the use of geoboard provided meaningful learning experiences through hands-on activities. By manipulating geometric shapes directly, students were able to understand the concepts more easily and actively participate in the learning process. These finding are consistent with the study by Zildjianshi et al. (2022), which reported that the use of geoboard as a learning medium increased students' engagement and facilitated their understanding of geometric concepts. Therefore, the implementation of geoboard contributed to the improvement of students' learning ourcomes in mathematics.

CONCLUSION

The study concludes that the use of geoboard manipulative media improved fourth-grade students' mathematical problem-solving skills. Students showed better ability to understand the problems, formulating a solution plan, implementing the problem solving plan, and double checking their answer. The improvement was reflected in the increased scores achieved across the research cycle, indicating that the predetermined success indicators were met. In addition, instructional planning and classroom implementation using

the geoboard improved progressively in each cycle, supported by better teacher performance and student learning activities. Improved with each cycle based on the results of observations until it reached the "very good" category, meaning that all components of instruction were in line with the research objectives. Instruction using geoboard was conducted in accordance with the learning stages outlined in the teaching module. Students average learning outcomes improved in each cycle, there by meeting the established research success indicators.

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