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# IMPROVING PROBLEM SOLVING ABILITY THROUGH A SCIENTIFIC APPROACH ON GRADE VII MTs STUDENTS

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**ABSTRACT**

Problem-solving skills are highly important in various aspects of life and professions, particularly in mathematics education. However, many students struggle to develop these skills due to a lack of understanding, critical thinking abilities, practice, and motivation. To address this, educators need to adopt teaching strategies that strengthen students' problem-solving skills. One effective approach is the scientific learning model, which emphasizes the scientific process, critical thinking, collaboration, and real-world applications. This study aims to assess the improvement of seventh-grade students' mathematical problem-solving skills using the scientific learning model. The research utilizes a descriptive quantitative approach with a two-group pretest-posttest design. The sample consists of seventh-grade students from an Islamic Junior High School, and data collection includes pretest and posttest questions. The N-gain formula is used to measure improvement. The findings indicate a significant improvement in problem-solving abilities among students who receive instruction using the scientific learning model compared to those who do not. The improvement is categorized as moderate in the experimental class, while the control class shows a lower level of improvement. Factors such as students' enthusiasm, implementation of real-life problems, and increased independence contribute to the improvement in students' problem-solving abilities. The implementation of the scientific learning model significantly enhances students' mathematical problem-solving skills. Based on the field findings, there is a need for improvement in soft skills to support meaningful learning activities.



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## INTRODUCTION

Problem-solving skills are a crucial ability in everyday life as well as in various professions. This skill involves an individual's ability to identify, analyze, and solve problems effectively and efficiently. The importance of problem-solving skills cannot be underestimated as they help individuals face challenges and overcome barriers in various contexts. Additionally, the importance of problem-solving skills is valuable in tackling complex and dynamic challenges in the real world, enabling individuals to navigate unexpected situations, identify effective solutions, and make appropriate decisions (Araiza-Alba et al., 2021; Shaffer et al., 2015).

Considering this, it is essential for students to possess problem-solving skills, especially in solving mathematical problems. Problems arise when students have a lack of understanding of concepts, critical thinking skills, practice, and motivation, thus impeding their development of problem-solving abilities. It is important for educators and the education system to recognize these challenges and adopt teaching strategies that strengthen students' problem-solving skills so that they can face the future more effectively. According to the National Council of Teachers of Mathematics (2000), five core competencies for problem-solving, reasoning, connection, communication, and representation are included in the thinking methods of mathematics learning. The low quality of human resources may be a result of this inability. The inflexibility in the instructional process hinders students from developing their problem-solving skills, resulting in a low problem-solving capacity.

Considering this, a learning model that can support problem-solving steps is necessary. One of the learning models that can be applied is scientific learning because the scientific learning model effectively enhances students' problem-solving abilities. By emphasizing the scientific process (Bybee, 2004), critical thinking skills (Osborne et al., 2004), collaboration (Johnson & Johnson, 1999), and application of knowledge in real-world contexts (Kolb, 1984), this model provides students with a more profound and relevant learning experience. It is important for educators to adopt the scientific learning model in their teaching practices to help students develop the problem-solving skills needed to face future challenges. According to Aripin (2013), middle school students usually have below-average abilities in solving mathematical puzzles, as it is estimated that only 10% of students in each class have the ability to solve problem-solving exercises. With challenging problem-solving indicators, such as formulating mathematical models or developing solutions, most students are only skilled at applying concepts or formulas to common problems with pre-existing mathematical models. However, there are several challenges in translating narratives into mathematical models. Based on the description provided above, mathematical problem-solving skills seem to be highly important for students, and educators should strive to ensure that students have these skills at their highest level.

Based on the findings from the conducted study, the objective of this research is to determine whether there is significant improvement in the mathematical problem-solving skills of seventh-grade students using the scientific learning model.

## METHOD

The method used in this research is descriptive quantitative. The research employs a two-group pretest-posttest with control group design, where this method compares the results from two sample classes, namely the control class and the experimental class as seen in Table 1.

**Table 1.** Research Method

| Class | Pretest | Treatment | Posttest |
|---|---|---|---|
| Experiment | O | X | O |
| Control | O | | O |

Information:

0 : problem solving ability

X : learning a scientific approach

The population of this study consists of all 7th-grade students of Islamic Junior High School (MTS), with the sample being students from MTS Cianjur. The sample size for each class consists of 30 students. Data collection for the research was conducted using pretest and posttest questions, and the measurement of improvement utilized the N-gain formula. The following table is used for categorizing N-gain improvement:

**Table 2.** N-Gain Score Criteria

| N Gain Score | Criteria |
|---|---|
| Score > 0.7 | High |
| 0.3 ≤ Score ≤ 0.7 | Middle |
| Score < 0.3 | Low |

Source: (Meltzer, 2002)

## RESULTS AND DISCUSSION

### *Results*

Sorting the test classes based on the results of the end-of-semester exams allowed for a comparison between students with different initial abilities. This approach aimed to determine whether there were any significant differences in learning outcomes based on the teaching approach employed. The mean test results were analyzed to establish a baseline for comparison and to ensure a fair distribution of students across the control and experimental classes. This initial analysis provided valuable insights into the effectiveness of the chosen teaching methods.

Following the sorting process, an initial assessment in the form of a pretest was conducted for both the control and experimental classes. This step allowed researchers to gauge the students' problem-solving abilities at the beginning of the study. By following a structured problem-solving approach, the pretest assessed the students' skills in observation, data collection, association, and communication. The results of the pretest served as a reference point to measure the growth and improvement of students' problem-solving abilities throughout the study.

During the 4-week duration of the study, the experimental class engaged in learning activities using a scientific approach. This approach involved hands-on, inquiry-based learning experiences, where students actively participated in various problem-solving tasks. They were encouraged to observe, collect relevant data, make associations, and communicate their findings. In contrast, the control class received instruction through the traditional lecture method, where the teacher delivered information in a more passive manner. The study allowed for a comprehensive comparison between the outcomes of these different teaching approaches, providing insights into the impact of the scientific approach on students' problem-solving skills. After the completion of the learning activities, it concluded with a final assessment in the form of a posttest to obtain data on students' learning outcomes. The teaching concept using the scientific approach is presented in Table 3.

**Table 3.** Main Treatment Activities in Experiment Class

| Activities | Description |
|---|---|
| Observe | Students observe the problems raise by teacher |
| Ask | Teacher give trigger questions about the |

| | |
|---|---|
| | problem |
| Data Collection | Students collect information from the problem given |
| Associate | Students discuss in their respective group about the results of gathering the information they get |
| Communicating | Students present the results of the discussion in front of class |

Source: (Rimelda Sibuea & Sukma, 2021)

Before the learning activities take place, a test is conducted on the students to determine the extent to which the class is homogeneous. From the results of the initial assessment, the statistical test showed a significant p-value of 0.837, sig > 0.05, indicating that there were no differences in problem-solving abilities at the initial stage. Then, at the end of the learning process, another test is conducted on both test groups, and the results are calculated using the posttest mean test with testing stages for normality in table 5.

**Table 5**. The normality test of normalized postest

| Group | Statistic | df | Sig. |
|---|---|---|---|
| Experimental | 0.144 | 30 | 0.117 |
| Control | 0.136 | 30 | 0.166 |

We also tested the homogeneity, and the results can see in table 6.

**Table 6**. Test of homogeneity of variance of Postest

| | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| Based on Mean | 0.025 | 1 | 58 | 0.875 |

Also we tested the two-mean test, and the results as presented in Tables 7.

**Table 7**. Independent sample T-Test

| Competency | t | df | Sig. |
|---|---|---|---|
| Improvement in mathematical Aproach | 6.616 | 58 | 0.000 |

From the test results, a significance of 0.000 < 0.05 was obtained, indicating a significant difference in student learning outcomes between those who received treatment and those who did not receive treatment. Meanwhile, for the mean N-gain test, values were obtained as displayed in Tables 8.

**Table 8**. Independent sample T-Test

| Competency | t | df | Sig. |
|---|---|---|---|
| Improvement in mathematical Aproach | 7.130 | 58 | 0.000 |

Based on the N-gain test results, a significance of 0.000 < 0.05 was obtained, indicating an improvement in problem-solving outcomes in the experimental class compared to the control class.

The improvement in the experimental class falls under the moderate category, while the control class shows a low level of improvement.

### *Discussions*

From the above research findings, there are several factors that contribute to the improvement of students' problem-solving abilities. These factors include:

- Students' enthusiasm in learning activities (Priyadi & Agustiningsih, 2016).
- Alignment between the taught material and real-life problems (Sudria; I et al., 2019).
- Enhancement of students' independence in problem-solving (Sofianti et al., 2021).

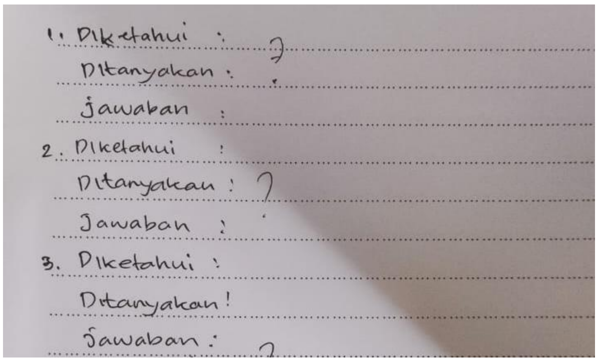
The implementation of these three factors has shown significant positive impacts (Haji & Widada, 2017).

**Figure 1.** During this group learning activity, students collaborate to compile initial information

Figure 1 shows the enthusiasm of students in compiling information both collaboratively and independently to gather pieces of information that can solve the given problem. Afterward, they attempt to communicate what they have discovered to the teacher as a mentor in this learning activity, as depicted in Figure 2.

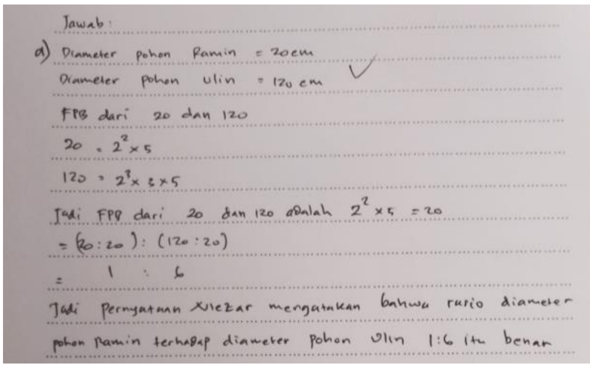
**Figure 2.** Group Mentoring in Learning Activities

As for the issues that arise during the learning activities, there is a time constraint ( (Anjarsari, 2019), where scientific model activities require sequential implementation of the following stages: a) Observing, b) Collecting data, c) Associating, d) Communicating. Regarding the test results, there were challenges observed in the low-ability group of students who only grasped the concept up to the required problem-solving stages, as depicted in Figure 3. In this figure, students only wrote the known concept and answered the given questions. On the other hand, students with moderate abilities were capable of elaborating on the problem and effectively formulating solutions, as shown in Figure 4.



1. Diketahui : ?
Ditanyakan :
Jawaban :
2. Diketahui :
Ditanyakan : ?
Jawaban :
3. Diketahui :
Ditanyakan !
Jawaban : ?

**Figure 4. Low Group Student Answer Results**



Jawab :
a) Diameter pohon Ramin = 20 cm
Diameter pohon ulin = 120 cm
FPB dari 20 dan 120
$20 = 2^2 \times 5$
$120 = 2^3 \times 3 \times 5$
Jadi FPB dari 20 dan 120 adalah $2^2 \times 5 = 20$
$= (20 : 20) : (120 : 20)$
$= 1 : 6$
Jadi Pernyataan Xlezar mengatakan bahwa rasio diameter pohon Ramin terhadap diameter pohon Ulin 1:6 itu benar

**Figure 5. Results of Student Answers in the Medium Group**

However, the results of both the posttest and N-gain tests indicate that the scientific learning model significantly enhances students' problem-solving skills in the subject of fraction material when compared to the absence of treatment in the form of implementing the learning model for students.

## CONCLUSION

In the conducted research activities, significant improvements in problem-solving skills were observed among students. This achievement can be attributed to several factors, such as nurturing students' independence, fostering their motivation, and addressing real-life problems that they encounter. By encouraging students to take ownership of their learning and providing them with meaningful and relevant challenges, their ability to analyze and solve problems was notably enhanced.

However, one of the major challenges encountered during the research was the effective management of timing in the learning activities. It is crucial to ensure that each stage of the learning model is executed efficiently and adequately. Proper time allocation for each step is essential to allow students to thoroughly engage in the observing, data collection, associating, and communicating processes. Addressing this concern would ensure the seamless implementation of the scientific learning model, maximizing its impact on students' problem-solving abilities.

Furthermore, for future research endeavors, it is imperative to place emphasis on developing students' soft skills alongside their cognitive growth. While enhancing their intellectual capacities is crucial, equal attention should be given to nurturing their affective abilities. This holistic approach would foster a well-rounded development of students, enabling them not only to excel in problem-solving but also to exhibit emotional intelligence, effective communication, and collaborative skills. By focusing on both cognitive and affective aspects, future studies can explore the comprehensive growth of students in various learning domains.

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