# Investigating Self-Efficacy in Improving Mathematical Problem-Solving Skills in Elementary School Students Through the Missouri Mathematics Project

**Abstract.** This study is quantitative research with a quasi-experimental approach. The research design is a non-equivalent control group, covering two classes, namely the control and experimental classes. The aim is to explore the influence of the Missouri Mathematics Project (MMP) learning model on mathematics problem-solving skills based on the self-efficacy of elementary students. The population of the study was all students of grade 5 at SD Negeri 3 Parepare, South Sulawesi, which involved two classes. A cluster random sampling approach was used to determine the sample. Data collection techniques used tests to obtain the results of mathematics problem-solving skills, observation sheets for learning implementation, and questionnaires for students' self-efficacy. Descriptive and inferential statistical analysis techniques were used to examine data analysis methodologies. The study's results reveal that 1) implementing the MMP and Discovery Based Learning model can improve students' mathematics problem-solving skills. 2) there is a difference in the effect of students' mathematical problem-solving abilities who have high self-efficacy after applying the MMP learning model and Discovery Based Learning.

## INTRODUCTION

Mathematics is expected to be able to educate people to think logically, theoretically, rationally, and confidently. The importance of mathematics increases students' ability to think logically, is structured, and helps solve problems so that learning mathematics will hone thinking skills and self-confidence. Every mathematics lesson hopes that all students get maximum mathematics learning outcomes. However, in the context of Indonesia, these expectations have not been fully met. Such as the results of the national mathematics exam, which tends to decline from year to year in various regions [1] or the results of international assessments in the subject of mathematics which also show unsatisfactory results [2]. The data also shows that students still have difficulties in learning mathematics.

Apart from cognitive aspects, several difficulties experienced by students in learning mathematics are also impacted by affective aspects: beliefs, attitudes, and emotions [3-6]. This can be seen in the student's ability to solve mathematical problems. Apart from the lack of students getting the opportunity to practice solving mathematical problems, it is also due to the lack of self-efficacy among students. In this case, various studies have shown that one aspect that influences students' success in solving math problem-solving well is self-efficacy [7-12].

Self-efficacy is considered a factor that can encourage an increase in the level of performance and affect the success of completing an activity, as well as determining how to feel, think, be self-motivated, and act [13]. Such beliefs produce diverse effects through four main processes: cognitive, motivational, affective, and selection. There is evidence that students with positive self-efficacy are more willing to participate, work harder, last longer, and have fewer adverse emotional reactions when facing problems and difficulties [1]. If it is associated with learning achievement in mathematics, then the assessment of students' self-efficacy in mathematics subjects can contribute to

learning achievement in mathematics. The existence of high self-efficacy in mathematics lessons encourages students to be diligent and try very hard, pay attention and look for learning strategies to learn and do math assignments [10,11].

In order to develop and improve students' mathematical problem-solving abilities, activities are needed that provide opportunities for them to use their thinking power, generate ideas, find problem solutions that they can develop themselves, and use their opinions. One of the learning models is one learning model designed to help teachers use exercises effectively to encourage students to improve their mathematical problem-solving skills is the MMP learning model. The MMP learning model is designed to improve students' ability to understand concepts and solve problems related to mathematical problem solving so that, in the end, students can build their answers [15] Students have much experience in solving practice questions in the form of project assignments while still paying attention to time allocation. In addition, the tasks in this project are related to the student's learning about the things around them. The MMP is a program designed to assist teachers in effectively using exercises so that students achieve improved problem-solving skills [15]. The exercise is a project assignment sheet containing questions or commands to develop mathematical ideas or concepts. Through this exercise, it is expected that students' ability to solve problems will increase. The syntax of the MMP learning model is a review, development, seatwork, job assignment, and detailed review [15].

or this reason, it is essential to investigate through a study that will answer the questions: 1) Is the MMP able to improve students' problem-solving skills? Moreover, 2) How is the problem-solving ability of students after participating in mathematics lessons with the MMP seen from their self-efficacy abilities?

## RESEARCH METHOD

This type of research is a quantitative study with a Quasi-Experimental approach with a nonequivalent control group design. A quasi-experimental design is a development of the true experimental design. The research design used an experimental group and a control group but could not fully control the external variables that could affect the implementation of the experiment [16-17]). This study has two types of variables: the MMP learning model and self-efficacy as the independent variable and students' mathematical problem-solving ability as the dependent variable. This study determined the effect of the MMP learning model on mathematical problem-solving abilities in terms of the self-efficacy of elementary school students in Parepare, South Sulawesi, Indonesia. The population in the study were all fifth-grade students of SD Negeri 3 Parepare, which consisted of 2 classes. Sampling using cluster random sampling technique. Data collection techniques used tests for the results of mathematical problem-solving abilities, observation sheets for the implementation of learning, and questionnaires for students' self-efficacy. The data analysis technique uses descriptive and inferential statistical analysis techniques. Inferential statistical analysis tests hypotheses with an independent sample t-test and a two-way ANOVA test.

## RESULTS

The following data were obtained based on the observations on the implementation of the MMP learning model in mathematics learning. Table 1 shows that the implementation of the MMP at SD Negeri 3 Parepare in learning mathematics, the average total implementation of learning is 4.4, which is in the well-implemented category.

**TABLE 1.** Results of Observation of the Implementation of the MMP Learning Model

| Learning | Average | Category |
|---|---|---|
| Learning 1 | 4.2 | Good |
| Learning 2 | 4.3 | Good |
| Learning 3 | 4.5 | Good |
| Learning 4 | 4.6 | Veri Good |
| Average | 4.4 | Well Implemented |

Table 2 shows that of the 24 students who were the research sample, 24 students obtained a pre-test score in the very low category of math problem-solving ability before applying the MMP learning model. Meanwhile, for the post-test, it can be seen that of the 24 students: 2 students scored low category math problem-solving abilities, 16 students got moderate math problem-solving ability scores, 5 students got high math problem-solving ability scores, and 1 student got very high math problem-solving ability score after the application of the MMP learning model.

**TABLE 2.** Frequency Distribution of Students' Mathematical Problem Solving Ability Levels Through the Application of the MMP Learning Model

| Interval | Category Student mastery | Pre-Test | | Post-Test | |
|---|---|---|---|---|---|
| | | F | % | F | % |
| 0.00 – 54.99 | Veri low | 24 | 100 | 0 | 0 |
| 55.00 – 64.99 | Low | 0 | 0 | 2 | 8 |
| 65.00 – 79.99 | Middle | 0 | 0 | 16 | 67 |
| 80.00 – 89.99 | High | 0 | 0 | 5 | 21 |
| 90.00 – 100.00 | Very High | 0 | 0 | 1 | 4 |

The criteria for completeness of mathematical problem-solving abilities set at SD Negeri 3 Parepare is 65. Based on these standards, the level of achievement of students' classical mathematical problem-solving abilities in classes taught through the MMP learning model can be seen in the following table.

**TABLE 3.** Distribution of Frequency and Percentage Improvement of Students' Mathematical Problem Solving Ability Scores with the MMP Learning Model

| Score | Categori | f | % |
|---|---|---|---|
| $g < 0{,}3$ | Low | 0 | 0 |
| $0{,}3 \leq g < 0{,}7$ | Middle | 19 | 79 |
| $g \geq 0{,}7$ | High | 5 | 21 |

According to table 3, of the 24 students that constituted the study sample, 19 scored in the medium category, and 5 scored in the high category in terms of improving problem-solving skills after implementing the MMP learning model.

**TABLE 4.** Data on Student Self-Efficacy Questionnaire Results on Students' Mathematical Problem Solving Ability with the Application of the MMP Learning Model

| Statistic | Value Statistic |
|---|---|
| Scor | 24 |
| Scor ideal | 60 |
| Mean | 40.67 |
| Standard Deviation | 6.68 |
| Range | 21 |
| Minimum | 32 |
| Maximum | 53 |
| Skewness | 0.49 |

According to table 4, it can be seen that the average student self-efficacy score of 40.67 is in the medium category. The frequency distribution of students' self-efficacy level criteria after applying the MMP learning model at SD Negeri 3 Parepare can be seen in the following table.

**TABLE 5.** Frequency Distribution of Students' Self-Efficacy Scores with the MMP Learning Model

| Score | Categori | F | % |
|---|---|---|---|
| $X < 35{,}61$ | Low | 7 | 29 |
| $35{,}61 \leq X < 48{,}65$ | Middle | 11 | 46 |
| $48{,}65 \leq X$ | High | 6 | 25 |

## Testing Hypotesis

Hypothesis testing was conducted to determine whether there was a significant effect of the application of the MMP learning model on students' mathematical problem-solving abilities in terms of self-efficacy (high, medium, and low).

**TABLE 6.** Results of Two Way Anova Analysis

*Tests of Between-Subjects Effects*

*Dependent Variable:* *Posttest*

| *Source* | *Type III Sum of Squares* | *Df* | *Mean Square* | *F* | *Sig.* |
|---|---|---|---|---|---|
| Corrected Model | 1226.411[a] | 5 | 245.282 | 7.681 | .000 |
| Intercept | 242796.846 | 1 | 242796.846 | 7602.928 | .000 |
| Interaction | 1226.411 | 5 | 245.282 | 7.681 | .000 |
| Error | 1341.255 | 42 | 31.935 | | |
| Total | 251976.000 | 48 | | | |
| Corrected Total | 2567.667 | 47 | | | |

a. R Squared = .478 (Adjusted R Squared = .415)

Table 6 shows the results of the SPSS 22 for Windows analysis obtained f-count = 7.681 with a sig value. = 0.000 < 0.05. This shows differences in students' mathematical problem-solving abilities in terms of students' self-efficacy (high, medium, and low) after applying the MMP learning model.

## DISCUSSION

The data analysis showed increased students' ability to solve mathematical problems after their mathematics learning was applied to the MMP and Discovery-Based Learning models. The average score of students' mathematical problem-solving abilities in class 5A, which uses the MMP learning model, is 72.25, which falls into the medium category. The average score of students' mathematical problem-solving abilities in class 5B, which uses Discovery-Based Learning, falls into the medium category. The difference in the mean scores of the MMP and Discovery Based Learning shows an insignificant difference between students' mathematical problem-solving abilities in the MMP and Discovery Based Learning. Based on the data analysis, it can be concluded that there is no difference in the effect of students' mathematical problem-solving abilities in general among students who follow the MMP learning model with Discovery-Based Learning. Thus the two learning models used in learning mathematics can improve students' mathematical problem-solving abilities. This is in line with the results of previous research, which concluded that the MMP was able to encourage the improvement of students' mathematical problem-solving abilities [18-24]. Likewise, the Discovery Based Learning model [25-26].

The SPSS 22 for Windows analysis obtained f-count = 7.681 with a sig value. = 0.000 < 0.05. The data analysis showed that, in general, there are differences in problem-solving abilities of students who have self-efficacy (high, medium, and low) and both who study using the MMP with Discovery-Based Learning. This means a significant increase in the mathematical problem-solving ability of students with high self-efficacy after following the MMP and Discovery-Based Learning learning models. Every mathematics teacher needs to consider when determining a learning approach not only to focus on the development of cognitive aspects but also important to pay attention to the development of affective aspects such as self-efficacy [27]. This is in line with the results of previous studies, which confirmed that those with high self-efficacy could solve problems better [24]. Other experts agreed that students with higher self-efficacy answered more problems correctly and preferred to rethink more problems than students with lower self-efficacy [28]. It was also emphasized that self-efficacy in learning mathematics was a strong predictor of students' mathematical problem-solving abilities as a general mental ability and a variable that is generally found to be a strong predictor of academic performance [29].

## CONCLUSION

Based on the inferential analysis results, the following things were found. 1) Implementing the MMP and Discovery Based Learning model can improve students' mathematics problem-solving skills. Although descriptively, there are differences, inferentially, there are no significant differences. 2) there is a difference in the effect of students' mathematical problem-solving abilities who have high self-efficacy after applying the MMP learning model and Discovery Based Learning.

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