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The Effectiveness of the Application of the Missouri Mathematics Project Learning Model on Solving Mathematical Problem

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ABSTRACT
This study aims to determine the effectiveness of the *Missouri Mathematics Project* learning model on students' mathematical problem-solving. This research is a pre-experiment with a quantitative approach with a sampling technique that is random cluster sampling. Data retrieval was carried out using learning implementation observation sheets, problem-solving tests, learning motivation questionnaire sheets, student activity observation sheets, and student response questionnaires. The data analysis technique used is descriptive and inferential statistical analysis techniques. The results of descriptive statistical analysis showed: (1) the average learning implementation was 3.5 (very well implemented), (2) the post-test average results were 77.22 (medium category), (3) the normalized average gain was 0 .63 (medium category), (4) the average percentage of student activity is 87% (very active category), (5) the average percentage of students who give a positive response is 80.04%. The results of inferential analysis show: (1) the average value of problem-solving of students who are taught with the Missouri Mathematics Project learning model is greater than 69.9 (KKM), (2) the average value of normalized gain is greater than 0.29 (category of moderate), (3) the average classical completeness is less than 80%. In general, it can be concluded that learning with the *Missouri Mathematics Project* learning model is effective in solving problems, activities, and student responses in learning mathematics.

Keywords: *Effectiveness, Missouri Mathematics Project Learning Model, Problem Solving*

1. INTRODUCTION

Education is a very important aspect of human life because education can help humans in developing themselves to be able to deal with any changes that occur. Mathematics is a general science that underlies modern technology development, has an important role in various disciplines, and develops human thinking power [1]. Mathematics lessons need to be given to all students starting from elementary school to equip them with the ability to think logically, analytically, systematically, critically, innovatively, and creatively, as well as the ability to work together. The national council of teachers of mathematics (NCTM) stipulates that students must have five main abilities in mathematics, namely problem solving, reasoning, communication, pattern or relationship tracing, and representation, to achieve content standards. NCTM defines problem-solving as a goal and an approach. Solving a problem means answering a question where to find a solution to the statement. In addition, the importance of problem-solving is an integral part of learning mathematics, so it cannot be separated from learning mathematics.

One of the learning models that can be applied is the Missouri Mathematics Project (MMP) learning model. The Missouri Mathematics Project is a program designed to help teachers effectively provide exercises to students so that teachers can make students stand out in their achievements. For this reason, students are required to be active, focused, and work independently with the given exercises [2]. This MMP learning model contains things that can streamline students' time, namely reviews of previous material, developing new ideas as an extension of previous mathematical concepts, providing controlled exercises, giving independent assignments to

students, and giving homework so that students' time can be used effectively. possible both inside and outside the school environment. In addition, this model is designed to be able to solve problems and solve mathematical problems so that in the end students can construct their own answers because of the many experiences students have in solving practice questions.

This research is supported by related research conducted previously. Ansori and Aulia [3] examined the application of the Missouri mathematics project (MMP) learning model to the problem-solving abilities of students in junior high school. The results show that students' problem-solving abilities are in a good category for the steps to understand the problem, plan a solution, and carry out the plan of completion and re-examine. Also, student learning activities using the MMP model are in a good category. This study focuses on solving student problems. The purpose of this study was to determine whether there was an effect of the MMP model on students' problem-solving in learning mathematics. The research subjects were students of class XI SMA. Subjects were given math problems to reveal students' problem-solving. The math problem given is a matrix problem.

2. LITERATURE

2.1. Learning Effectiveness

Sandhily ([4]) provides an understanding that the effectiveness of learning is the success of the influence due to the use of the learning approach used. Furthermore, Slavin ([4]) states that learning effectiveness consists of four indicators, namely the quality of learning, the suitability of the level of learning, incentives, and time.

2.2. *Math Problem Solving*

According to Wardhani ([5]), problem-solving is the process of applying previously acquired knowledge to unfamiliar situations. Based on this, it can be concluded that students can solve problems if they have the ability to understand problems, mathematical design models, complete models, and interpret the solutions obtained. According to Polya ([5]), the solution to the problem-solving problem has four stages of completion, namely:

1) Understanding the Problem
2) Planning Completion
3) Troubleshooting
4) Doing Back Check

2.3. *Missouri Mathematics Project (MMP) Learning Model*

The Missouri Mathematics Project learning model includes five stages of activities. Shadiq [6] reveals the five stages are as follows:

a. Review

Review means reviewing past lessons, especially those related to the material to be studied in the lesson, discussing questions on homework that are considered difficult by students, and generating student motivation.

b. Development

The activities carried out are presenting new ideas and extensions, discussions, and demonstrations with concrete examples. This activity can be done through class discussion.

c. Controlled exercise

Students in groups respond to questions under the supervision of the teacher. This supervision is helpful to prevent misconceptions in learning.

d. Seatwork/self-employed

In this step, students individually or in learning groups respond to questions for practice or expansion of concepts that have been learned in the development step.

e. Assignment/Homework

In the MMP learning model, students are given an exercise task called a project assignment which contains a series of questions or commands to develop an idea from a mathematical concept.

3. RESEARCH METHOD

This research is a pre-experimental design research. This study involved one class as an experimental and treatment class intending to know the effectiveness of the Missouri mathematics project learning model in students' mathematics learning. The research design that has been used in this study is the one-group pre-test post-tests design [7].

This research was conducted at SMA Negeri 3 Polewali. The population in this study was class XI MIPA SMA Negeri 3 Polewali, which consisted of five classes with a total of 163 students. The sampling technique used in this study is the cluster random sampling technique.

The research instruments used were 4 (four) kinds, namely: (1) Initial test in the form of a description test, (2) Student activity sheets in the form of student activity sheets, (3) learning

implementation observation sheets, (4) Giving final tests to students. Sample class to determine students' mathematical problem-solving abilities on the material being taught, and (5) response questionnaire.

The collected data will be analyzed using two kinds of statistical analysis techniques, namely descriptive statistical analysis, and inferential statistical analysis. Descriptive statistical analysis used descriptive statistics were used to describe the characteristics of the respondents' scores for each group. Meanwhile, inferential statistical analysis is used to test the research hypothesis. The analytical method used in this study is quantitative analysis using a t-test, namely a one-sample test at 95% confidence level $\alpha = 0.05$.

4. RESULTS AND DISCUSSION

4.1. Research Implementation Analysis

Data on the learning model implementation was obtained from the observation sheet on the implementation of learning, which was observed during four meetings. The results of the research implementation data are then summarized in the table below.

Table 1. Summary of data on the implementation of the missouri mathematics project learning

Meeting	Average Skor	Category
I	3.05	Well done
II	3.64	Well done
III	3.70	Well done
IV	3.58	Well done
Total	**3,50**	Well done

Based on the table, it is known that overall for the four meetings of the implementation of learning can be carried out quite well, which means that the criteria for implementing the Missouri Mathematics Project learning model for the implementation of learning are met. This is indicated by the average score of learning implementation from the first meeting to the fourth meeting of 3.5.

4.2. Descriptive Statistical Analysis

4.2.1. Mathematical Problem Solving

From the results of processing students' mathematical problem-solving data based on the results of pretest, posttest, and normalized gain, it is obtained a recapitulation of student problem-solving data as shown in table 2. below

Table 2. Distribution of problem-solving frequency

Interval	Category	*Pretest*		*Posttest*	
		Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
0-54	Very Low	30	100	2	6.67
55-64	Low	0	0	4	13.33
65-79	Currently	0	0	8	26.67
80-89	High	0	0	14	46.66
90-100	Very High	0	0	2	6.67
Sum		**30**	**100**	**30**	**100**

In terms of students' mathematical problem-solving abilities, the results showed differences in students' mathematical problem-solving skills before being given treatment and students' mathematical problem-solving skills after being given treatment. The descriptive analysis of students' mathematical problem-solving ability data before treatment showed that the highest score was 49.45, the lowest score was 15.38, and the average value was 38.93. While the results of the descriptive analysis of students' mathematical solving ability data after being given treatment showed the highest score of 91.21, the lowest value of 61.54, and the average value of 77.21. So, students' moderate mathematical problem-solving ability after being given treatment was higher than the students' mathematical problem-solving abilities before being given treatment.

This study shows that students' problem-solving ability with the Missouri Mathematics Project learning model is dominant in the high category, with a classical mastery level reaching 73.33%. Problem-solving students' problem-solving increases after learning with the Missouri Mathematics Project learning model, this is shown by the average of students' normalized gain of 0.63, which is in the high category.

Based on the inferential analysis, the average comparison for the initial and final values was obtained. The initial value has an average value of 38.93, and the final score has an average of 77.21. This shows that there is an increase in students' mathematical problem-solving ability after the application of the Missouri Mathematics Project learning model.

This is in line with what Fauziah and Sukasno [8] said that the influence of the Missouri Mathematics Project model is due to the project sheet; students are given problem-solving questions, thus enabling students to become familiar with problem-solving questions. The classification of increasing problem

solving of students who are taught with the Missouri Mathematics Project learning model is calculated by the normalized gain formula. The results of the analysis are presented in table 3 below.

Table 3. Classification of normalized gain on increasing student problem solving with the application of the Missouri mathematics project learning model

Gain Normalization Coefficient	Total Student	Percentage (%)	classification
$g<0,30$	0	0	Low
$0,30 \leq g<0,70$	21	70	Currently
$g \geq 0,70$	9	30	High
Average		0,634	

Based on table 3 above, the increase in mathematical problem solving of students taught by applying the Missouri Mathematics learning model is mainly in the medium category; namely, as many as 21 students or 70% and 9 students or 30% are in the high category. Based on students' average pretest and post-test, the average increase in students' mathematical problem solving calculated by the normalized gain formula is 0.634. This means that the improvement of students' mathematical problem solving with applying the Missouri Mathematics Project learning model is in the medium category.

4.2.2. Student Activities

Student activity data were obtained through student activity observation sheets carried out during the learning process. The percentage of student activity meetings while applying the Missouri Mathematics Project learning model is summarized in table 5 below.

Table 4. Summary of Student Activity Observation Results

Meeting	Percentage (%)	Category
I	90	Very Active
II	85	Active
III	88	Very Active
IV	85	Active
Average	**87**	**Very Active**

Student activity data were obtained from student activity observation sheets filled out in each meeting and analyzed descriptively. Based on descriptive statistical analysis, the percentage of student activity is 87% in the very active category. This figure has met the effective requirements. Namely, at least 80% of students are active in learning. The Missouri Mathematics Project learning model makes students more active and skilled in the learning process because of the many questions given; this is in accordance with what was stated by Widdiarto [9] that one of the advantages of the Missouri Mathematics Project model is the amount of practice so that students are efficiently skilled with a various question.

4.2.3. Student Response

Student responses were obtained using a student response questionnaire and analyzed descriptively. Based on descriptive statistical analysis, it can be concluded that, on average, students gave a positive response to the application of the Missouri Mathematics Project learning model, reaching 80.04%, more than the minimum student response criteria of 80%. Most students feel happy with the applied learning so that they are more motivated to look active in the learning process, which in the end, can understand the lesson well.

4.3. Inferential Statistical Analysis

4.3.1. Normality Test

Table 5. Normality test results

Variable	Sig		Description
	Pretest	Postest	
Problem Solving Skill	0.200	0.069	Normally Distributed

Based on the table above, it is known that all variables have sig values. > 0.05 so that the data is normally distributed.

4.3.2. Hypothesis Testing

Table 6. Average problem-solving ability of students after application of using the missouri mathematics project learning minimum meets KKM (≥70)

Model	N	Mean	Std. Deviation	T	df	Sig. (2-tailed)
Post-test	30	77.2161	8.85226	4.527	29	0.000

Based on the table above, the test results show that the mean of the posttest is 77.21 and the P_value is 0.000. The tests conducted show that the mean of the posttest is greater than 69.9. The significance value is less than P_value = 0.05, which is 0.000, which means that it can be concluded that the average posttest score of students is more than KKM after students are taught with the Missouri Mathematics Project learning model. So it can be concluded that H_0 is rejected and H_1 is accepted, namely the average problem-solving score of students who are taught by applying the Missouri Mathematics Project learning model is greater than 69.9.

Table 7. Average Problem-Solving Ability of Students After Application Using the Missouri Mathematics Project Learning Model Minimum 0.3 (medium category)

Model	N	Mean	Std. Deviation	T	df	Sig. (2-tailed)
Post-test	30	0.6346	0.11305	16.697	29	0.000

Based on the table above, the test results show that the mean of the normalized gain value is 0.634 and the P_value is 0.000. The tests conducted show that the mean of the gain value is more than 0.29, and the significance value is less than P_value = 0.05, which is 0.000. So it can be concluded that H_0 is accepted and H_1 is rejected, namely, the increased problem-solving scores of students who are taught by the application of the Missouri Mathematics Project model of more than 0.29, which means that there is a significant increase in students' mathematical problem solving after being taught using the Missouri Mathematics Project learning model.

4.3.3. Proportion Test

The proportion test is classical completeness data after being taught using the Missouri Mathematics Project learning model. The results of this test are shown in the table below.

Table 8. Statistics of Classical Completeness Z-Test

Variable	$\mathbf{Z_{count}}$	$\mathbf{Z_{table}}$
Problem Solving	0.96	1.96

Based on table 8, it can be seen that Z_{count} of classical problem-solving completeness is 0.96 and Z_{table} is 1.96 with $\alpha = 0{,}05$. So it can be concluded that $Z_{count} \leq Z_{table}$, which means the classical problem-solving mastery of class XI MIPA 1 SMA Negeri 3 Polewali is less than or equal to 80% after being taught using the Missouri Mathematics Project learning model. So it can be said that H_o is accepted.

5. CONCLUSION

The conclusions in this study are as follows:

1. After applying the Missouri Mathematics Project learning model, students' problem-solving abilities are moderate, with average completeness of 77.22 from an ideal maximum score of 100.
2. The application of the Missouri Mathematics Project learning model is effective for problem-solving with the following criteria:
   - The average score of students' problem-solving abilities after the application of the Missouri Mathematics Project learning model meets the predetermined KKM
   - After being taught with the Missouri Mathematics Project learning model, the average increase in students' problem-solving abilities is 0.634, in the medium category.

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