

**THE EFFECT OF LEARNING MODELS MISSOURI MATHEMATICS
PROJECT WITH TWO STAY TWO STRAY METHODS FOR
MATHEMATICAL PROBLEM SOLVING ABILITY OF STUDENTS IN
7th GRADE SMP N 1 TAWANGMANGU**

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By

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THE EFFECT OF LEARNING MODELS MISSOURI MATHEMATICS PROJECT WITH TWO STAY TWO STRAY METHODS FOR MATHEMATICAL PROBLEM SOLVING ABILITY OF STUDENT IN 7th GRADE SMP N 1 TAWANGMANGU

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Abstract

This study aims to determine the effect of learning models of Missouri Mathematics Project with Two Stay Two Stray methods for mathematical problem solving ability of grade VII students of SMP N 1 Tawangmangu. The method in this study is a quasi experimental research design with pre-test post-test design group. The population in this study were all students of grade VII of State Junior high School 1 Tawangmangu. The sample in this research is grade VII F had treatment with Missouri Mathematics Project learning models of Two Stay Two Stray method as the experimental class and grade VII G as the control class who receive conventional learning treatment. This instrument were tests and observation sheets. The hypothesis test method used was one sample test and t-test independent sample. Based on the results of data analysis, the value of $t_{count} = 7,171 > t_{(0.05;31)} = 2,0395$ with a significance level of 5% thus H_0 rejected which means that the learning model of Missouri Mathematics Project with Two Stay Two Stray method was effective in terms of students' mathematical problem solving ability. The results of data analysis obtained the value of $t_{count} = 6,476 > t_{(0.05;62)} = 1,998971$ thus H_0 was rejected. This means that the learning model of Missouri Mathematics Project with Two Stay Two Stray method affected the ability of students' mathematical problem solving.

Keywords: Missouri Mathematics Project, Two Stay Two Stray, problem solving ability

INTRODUCTION

Mathematics grow and develop because of the thought process, so that the logic needed to learn mathematics. Each student has the ability of different logic that often students' difficulties in learning mathematics. This is a challenge for teachers so that their students can understand mathematics well. According to Erman Suherman (2003: 62), in mathematics at school, teachers should use strategies, approaches, methods, and techniques that involve students actively in learning, both mentally, physically, and socially.

Kline (Erman Suherman, et al 2003: 17), found that math is not knowledge alone that can be perfect for himself, but the math was mainly to help people understand and master the social, economic, and natural. Of the various opinions it can be concluded that mathematics is a science

that is structured and organized with regard to ideas as a means of thought, communication, tools to solve problems in helping people to understand and master the problems in life.

Basedon Kurikulum Tingkat Satuan Pendidikan (KTSP), which became one of the references of learning in Indonesia specifies four types of critical capabilities that must be mastered by the learners, those are solving problems (problem solving), reasoning (reasoning), communication (communication). One of the skills to be achieved in learning was problem-solving abilities. Problem solving ability is a high level of ability required in the study of mathematics and an important part of the mathematics curriculum. The function of problem solving in mathematics according to the NCTM (2000: 335) includes: (1) Solving the problem is an important tool to study mathematics. Many

mathematical concepts are introduced effectively to students through problem solving; (2) Troubleshooting can equip students with the knowledge and tools so that students can formulate, approach, and solve the problem in accordance with what they have learned at school. This is consistent with the purpose of learning mathematics which are developing the ability to: (1) mathematical communication, (2) the mathematical reasoning, (3) solving the problem mathematically, (4) connections mathematically, and (5) a mathematical representation (NTCM, 2000: 7) ,

There were several stages in the process of problem solving. O'Connell (2007: 17) states that the guiding learners to solve the problem requires the following steps (1) to understand the problem; (2) planning problem solving; (3) try the plan; (4) checks the answers and (5) reflects what has been done. According Hudojo and Sutawijaya (Herman Hudojo, 2001: 177-186), systematic instructions to resolve the problem are as follows: a) Understanding the problem, b) Planning troubleshooting, c) Implement planning problem resolution, d) Looking back over the settlement issue.

One of learning model that has been developed is Missouri Mathematics Project's (MMP) learning model. MMP is a learning model that structured development idea and expansion of mathematical concepts. The characteristics of MMP learning model is the project assignment sheet. Through the project tasks expected of learners can be skilled in solving problems and

has a wide experience in mathematical problem solving. Mathematics learning refers to MMP, students are required to be active in the learning because the teacher only as facilitators who assist and help students find knowledge. Students are introduced directly to the real object so as to increase the motivation of students to study and master the subject matter of mathematics. MMP is a learning model that consists of several steps. Model MMP includes 5 steps: (1) Introduction or reviews; (2) Development; (3) Exercise with Guidance Teachers; (4) Self-Employment; (5) Closing. In the MMP learning process, there is a cooperative learning in the implementation. One cooperative learning are deemed suitable for combination with MMP is Two Stay Two Stray (TSTS).

TSTS is one type of cooperative learning. This method provides the opportunity for students to practice the knowledge, skills, and give the group an opportunity to share the results and information to other groups, so that each student can actively participate in the learning process. Students are able to share ideas and information in solving a mathematical problem so finding the right solution. With the discussion and cooperation among students to solve problems will certainly impact both on students' mathematical problem solving ability.

Based on observations conducted by researchers in class VII SMPN 1 Tawangmangu the academic year 2014/2015 in February 2015, there were facts that there are still many students who have a tendency to memorize formulas

without understanding the concept and the process of finding a formula. This can be seen when students are given examples of problem solving is done together with the teacher, students can understand it. When students are given exercises or problems with a higher degree of difficulty than the example given earlier, students still visible confusion and difficulty in understanding and solving problems in accordance with the corresponding troubleshooting procedures. In addition, teachers are still using conventional learning where the teacher is still a center of learning that is closely related to the lecture and question and answer method. This causes less active students in the following study.

Based on research conducted by Soviana (2013) entitled "*Keefektifan Pembelajaran Matematika Mengacu pada Missouri Mathematics Project terhadap Kemampuan Pemecahan Masalah Materi Segiempat Kelas VII SMP N 21 Semarang*" with results improving mathematical problem solving ability of students. In addition, research conducted by Dona (2012) with the title "*Eksperimentasi Model Pembelajaran Kooperatif Tipe Two Stay Two Stray dengan Metode Problem Solving Pada Pokok Bahasan Persamaan Garis Lurus Ditinjau dari Kategori Multiple Intelligences Peserta Didik Kelas VIII SMP Negeri di Kabupaten Karanganyar*" shows that TSTS with Problem Solving produce better learning achievement.

Based on the description and relevant researches, researchers are interested in trying to

do research experiments by combining learning models Missouri Mathematics Project with Two Stay Two Stray methods for mathematical problem solving ability of students in class VII SMP N 1 Tawangmangu

RESEARCH METHOD

Type and Research Design

This study was a quasi-experimental research. The research design was pre-test posttest group design.

Table1. Research Design

	<i>Pre-test</i>	<i>Treatment</i>	<i>Post-test</i>
Control	Y ₁	C	Y ₂
Experimen	Y ₁	X	Y ₂

Time and Place

This research did at SMP N 1 Tawangmangu on March 10th to April 14th 2015.

Population and Sample

The population in this research was the students of grade 7th SMP N 1 Tawanmangu. The samples were students of class VII F as the experiment class and VII G as the control class. The sample had been chosen randomized.

Variables

In this research there were dependent variable, independent variables and control variables. The independent variable is the learning model. Missouri Mathematicsc Project learning model with Two Stay Two Stray method to be applied in the experimental class and

conventional learning to be applied in the control class. The dependent variable in this study is a mathematical problem-solving skills of students. The data of students problem-solving capabilities obtained from the students worksheet in completing the essays in the pre-test and post-test. Control variables in this study include the number of hours of teaching, learning materials, teacher, worksheets, and test questions. Learning material used in this research were lesson plan and the Student Activity Sheet (LKS) made in accordance with the number of meetings and hours of lessons in each meeting.

Data, Instrument, and Data Collection Techniques

The instrument used in this research was the instrument test and non-test instrument. Instrument tests in this study is a written test mathematical problem solving ability. This test is test description to be provided before and after the study. There are two stages of tests in this study, the pretest and posttest.

Non-test instruments in this research is observation sheet. Observation sheets used during the learning process. It aims to observe and record the student's activity during the learning process that is used by researchers.

Data Analysis Techniques

Statistical data analysis techniques used in this study were two stages, a preliminary analysis of which is to describe the analysis of mean, range / variance, assuming that the enforceability

of normality and homogeneity test, and the final analysis to test the hypothesis. Analysis of the data for the first hypothesis test using one sample test to determine the effectiveness of the learning model used. The hypothesis was

$$H_0: \mu \leq 74,99$$

(learning models Missouri Mathematics Project with Two Stay Two Stray methods were not effective to the mathematical problem-solving ability of student)

$$H_1: \mu > 74,99$$

(learning models Missouri Mathematics Project with Two Stay Two Stray methods were effective to the mathematical problem-solving ability of student)

Level of significant: $\alpha = 0,05$

The formula was

$$t = \frac{\bar{x} - \mu_0}{s / \sqrt{n}}$$

Notes:

- \bar{x} = The average score of posttest of experiment class
- μ_0 = 74,99
- s = Standart deviation
- n = The amount of student

The criteria of H_0 was rejected if $t > t_{tabel}$.

Analysis of the data for the second hypothesis test using independent sample t-test to determine whether the learning model MMP affect the ability of mathematical problem solving. Learning is said to be influential if there were significant differences between students' problem-solving abilities that learned by learning model Missouri Mathematics Project with Two Stay Two Stray methods and students that learned

with conventional learning models. The hypothesis was

- $H_0: \mu_1 = \mu_2$ there was no significant difference between problem-solving ability of students that learned with a learning model MMP with TSTS methods and students that learned with conventional learning models.
- $H_1: \mu_1 \neq \mu_2$ there was significant difference between problem-solving ability of students that learned with a learning model MMP with TSTS methods and students that learned with conventional learning models.

Level of significant: $\alpha = 0,05$

The formula was

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S_{gab} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

with $v = n_1 + n_2 - 2$ dan

$$S_{gab} = \sqrt{\frac{(n_1 - 1)s^2_1 + (n_2 - 1)s^2_2}{n_1 + n_2 - 2}}$$

Notes :

- \bar{x}_1 = The average score of posttest of experiment class
- \bar{x}_2 = The average score of posttest of control class
- n_1 = The amount of student in experiment class
- n_2 = The amount of student in controlclass
- S_{gab} = Total of standard deviation

The criteria of H_0 was rejected if $t > t_{tabel}$.

RESULTS AND DISCUSSION

Initial Condition of Research

Before conducting the study, researchers have conducted observations in advance. Based on observations conducted by researchers, still a lot of students who have a tendency to memorize formulas without understanding the concept and the process of finding a formula. This can be seen when students are given examples of problem solving is done together with the teacher, students can understand it. When students are given exercises or problems with a higher degree of difficulty than the example given earlier, students still visible confusion and difficulty in understanding and completing the corresponding problem. In addition, teachers are still using conventional learning where the teacher is still a center of learning that is closely related to the lecture and question and answer method. This causes less active students in the following study.

The learning process in the classroom experiments that gets Missouri Mathematics Project learning model with Two Stay Two Stray methods run in accordance with the lesson plan that was created earlier. Learning was done by delivery of material briefly with concrete examples by the teacher, the division of the group, the discussion LKS as a controlled exercise in each group. Students work in groups where each group consisting of 4 students. Then the teacher gives problems to be done in discussion. After finishing the discussion, each group will be formed into two smaller groups in

which two (2) students are guests and 2 (two) other students staying in the group. Two students who live in a group in charge of distributing the work and information to their guests, while students who were guests left the group to visit other groups. Some students write the result of discussion in class. Then teachers and students discuss the results of the answers. Furthermore, teachers distribute the project assignment sheet to be completed by students individually and reassembled after the specified time, the conclusion of the materials that have been studied, giving homework (PR), closing.

Although learning using learning model MMP methods TSTS goes according to plan, but there are some things that a difficulty in its application, such as during the study due to the unfavorable conditions of the class there were some students who do not follow the teaching of school due to illness. So that students are less involved fully in the learning process for six sessions in the area and perimeter of the material flat wake. This leads to less optimal development of capabilities that should be experienced. But the advantages of students in this class is the individual responsible for completing the work. This is because they work in groups, so if one friend can not work on a problem, then another friend kelompoknya can provide an explanation directly and can write as well as a good understanding of the steps work of guidance about other friends in the group.

Control class by learning using conventional learning model as a whole goes according to

lesson plan that was created earlier. Learning is done by distributing student teacher, doing worksheets, after several students write on the board the results of the process, then the teachers and students discuss together, inference materials that have been studied, giving homework, closing.

Learning in the control class can not be separated from some of the difficulties experienced in its application. In this class there are some students who do not do not follow school learning because of illness. So that students are less involved fully in the learning process for six sessions in the area and perimeter of the material flat wake. In addition, the clock math in this class is the last class hours on Saturday. It has also become one of the factors students are not motivated in learning. The teacher's role in this case is also important to be able to motivate the students.

Data Descriptions

The data of pretest results of the experimental class in this study can be seen in Table 1 below.

Table 1. The data of pretest result

Data	Number of Student	Score		Average	Std. Deviation
		Max	Min		
Control Class	32	59,7	36,30	48,1875	6,347
Experimen Class	32	59,7	37,10	48,2375	5,700

Based on the results of the pretest known that the number of control class students who take the pre-test as many as 32 students had the highest score 59,7 and the lowest score 36,30 and the average score of pre-test of control class was

48,188. In the experimental class the number of students who take the pre-test as many as 32 students get the highest score 59,7, the lowest score 37,10 and the average score of the pre-test experiment class was 48,2375.

The data of posttest results of experimental class can be seen in Table 2.

Table 2. The data of posttest result

Data	Number of students	Score		Average	Std. Deviation
		Max	Min		
Control Class	32	100	42	69,02	13,87397
Experimen Class	32	100	59	89,81	11,68270

Based on post-test results was known that the number of class control students who take the post-test as many as 32 students had the highest score 100 and the lowest score 42, and the average score of the post-test control class was 69,02. In the experiments the class by the number of students who take the post-test as many as 32 students get the highest score 100, the lowest score 59, and the average score of the post-test experimental class was 89,81.

The data obtained in this research attention to aspects of mathematical problem solving ability of students consisting of aspects of understanding the problem, settlement planning, problem solving, and interpret the answer to the original problem. Percentage scores students' problem solving ability can be shown in table 3.

Table 3. The Data of Percentage scores students' problem solving ability of experiment class and control class

No.	Aspects of Mathematical Problem Solving Ability	Experiment Class		Control Class	
		Pretest	Posttest	Pretest	Posttest
1.	Understanding problem	64,58	97,91	63,54	87,89
2.	Problem solving plan	36,98	83,15	36,07	48,12
3.	Solve the problem according to plan	64,49	96,45	63,64	83,86
4.	Interpret the answer to the original problem	20,83	66,4	21,74	29,04

Based on the table 7 can be seen that each step problem-solving abilities experienced an increase both in the experimental class and the control class. In addition, the ability to problem-solving experiment class experienced an increase higher than the control class.

Normality test used to determine whether the data were normally distributed or not. Normality test analysis results was

Table 4. The Normality Analysis

	Class	Significance	α	Result
Pre-test score	Control	0,200	0,05	Normal
	Experimen	0,200	0,05	Normal

From the table was known that significant value $\geq 0,05$. It shows that the data to be tested come from populations that were normally distributed.

Homogeneity test used was Levene's test is aided SPSS version 19.0 and manual calculations by using test-f. Homogeneity test results was

Table 4. Homogeneity test

Data	Significance	α	Result
Pre-test	0,545	0,05	Homogen

Based on the table 5 was known that the test results of pre-test of the control class and

experimental class produce $\geq \alpha = 0,05$ significance. This shows that the data pre-test of the control class and experimental class have the same variance.

The analysis of the initial capabilities of class control and experimental class can be seen in Table 6.

Table 6. The analysis result of the initial capabilities of class control and experimental class

Data	Sig. (2-tailed)	α	Result
Pre-test	0,974	0,05	experimental class and control class has the same initial capability

Based on the table 6 p-value known statistical t-test was 0,974 so that $\geq 0,05$ so H_0 not rejected or accepted. Thus, it can be concluded that the initial capabilities between the experimental class and control class is the same. After knowing that the initial capabilities between the experimental class and control class was same, then tested the hypothesis to answer the problem formulation.

The first hypothesis test used to answer the formulation of the first issue is whether the use of the learning model Missouri Mathematics Project with Two Stay Two Stray method effective against mathematical problem solving ability. A study said to be effective if the average value of the post-test students at least reach 75 based KKM used in accordance with the school. Results of the analysis of the first hypothesis test was

Table 7. The First Hypothesis Test

Group	Variabel	T	Df	Sig.
MMP with TSTS	Problem Solving Ability	7,171	31	0,000

From the analysis of data in table 7 above obtained value $t_{count} = 7,171 > t_{(0,05;31)} = 2,0395$ and a significance value $0,000 < 0,05$ so H_0 was rejected. In other words, learning models Missouri Mathematics Project with methods Two Stay Two Stray effective against problem-solving ability.

The second hypothesis test used to answer the second question, whether the formulation of the learning model MMP affect the ability of mathematical problem solving. Learning is said to be influential if there were significant differences between students' problem-solving abilities that learned with a learning model with methods Missouri Mathematics Project Two Stay Two Stray and students that learned with conventional learning models. The second hypothesis test analysis results was

Table 8. The Second Hypothesis Test

F	Sig	T	Df	Sig. (2-tailed)
1,451	0,233	6,476	62	0,000

From the analysis of the data in Table 8 obtained $t_{count} = 6,486 > t_{(0,05;62)} = 1,998971$ so H_0 rejected, then there was a significant difference between students' problem-solving abilities that learned with a learning model Missouri Mathematics Project with Two Stay Two Stray methods and students that learned with conventional learning models. This means that the learning model with methods Missouri Mathematics Project Two Stay Two Stray affect the ability of students' mathematical problem solving.

Discussion

This section describes the overall results of the study. The discussion covers the initial ability of students is based on the analysis of pretest and posttest results of the experimental class and control class. The learning model used in this study was learning models Missouri Mathematics Project with Two Stay Two Stray methods given to class VII F as experimental class and control class is the class that learning using conventional learning given to class VII G. The effect of this learning model is reviewed math solving abilities of students based on the results of post-test. Based on t-test against pretest results experimental class and control class, showed that the experimental class and control class has the same initial ability. Furthermore, based on the results of hypothesis testing one sample test to post-test results using SPSS software showed that the obtained value $t_{\text{count}} = 7,171 > t_{(0,05;31)} = 2,0395$ so H_0 was rejected. This means that the learning models Missouri Mathematics Project with Two Stay Two Stray method effective against mathematical problem solving ability of students and the average value of the minimum posttest reach 75 based on KKM used in accordance with the school is not rejected.

In addition there were significant differences between students' problem-solving abilities that learned with learning models Missouri Mathematics Project with Two Stay Two Stray methods and students that learned with conventional learning models. This is evident from the acquisition results of hypothesis testing

independent sample t-test on SPSS software shows that the values obtained $t_{\text{count}} = 6,486 > t_{(0,05;62)} = 1,998971$ so H_0 rejected, then there was a significant difference between students' problem-solving abilities that learned learning models Missouri Mathematics Project with Two Stay Two Stray methods and students that learned with conventional learning models. Based on the results of the analysis, it can be concluded that the learning model MMP method TSTS effect on mathematical problem solving ability of students in SMP N 1 Tawangmangu.

In addition, the average score of posttest obtained students who receive treatment with the MMP learning model TSTS method is 89,81. While the the average score of posttest obtained students who received treatment by conventional learning model is 69,02. The average difference in both classes is 20,79. Furthermore, each step problem-solving abilities experienced an increase in both the experimental group and the control group which had passed the experimental class is higher. Aspects of mathematical problem solving capabilities that experienced the highest increase was in the planning aspect of problem solving that experienced an increase of 46,17%. Based on the results of the analysis concluded that learning using learning model MMP with TSTS method for mathematical problem solving ability of students is better than learning by conventional learning.

Problem solving ability is a high level of ability required in studying mathematics. Measurement of mathematical problem solving

ability can describe how a student logical thinking to solve problems. Based on Gagne's learning theory proposed that the high intellectual skills can be developed through problem solving. Problem solving is the highest type of learning. Gagne divide it into eight types of learning those are signal learning, stimulus response learning, chaining, verbal association, discrimination learning, concept learning, rule learning, and problem solving. (Erman Suherman, 2003: 89). Solving problems in the solution consists of four stages, that is understanding the problem, determine the settlement of the problem, resolve the problem according to plan, and conduct checking back towards completion.

MMP is a learning model that structured idea development and expansion of mathematical concepts. MMP is usually applied together with cooperative learning. There are several common steps (syntax) of a learning model MMP, those are (1) the introduction or review, (2) development, (3) the exercise of control, (4) seat work (self-employment), and (5) the assignment or homework. The purpose of the study with MMP learning model is the presence of project tasks intended to meperbaiki communication, reasoning, interpersonal relations, decision making skills and ketrampilam solve problems (Rosani, 2004: 5). Characteristics of MMP learning model is the project assignment sheet. Through the project tasks expected of learners can be skilled in solving problems and has a wide experience in mathematical problem solving. On learning of mathematics which refers to MMP,

students are required to be active in the learning because the teacher only as facilitators who assist and help students find knowledge. Students are introduced directly to the real object so as to increase the motivation of students to study and master the subject matter of mathematics. Teachers will provide an open attitude towards relevant ideas proposed by students. This will provide the opportunity and time for students to reinforce learning materials, as well as the ability to solve mathematical problems given.

Two Stay Two Stray is one type of cooperative learning. This method provides the opportunity for students to practice the knowledge, skills, and give the group an opportunity to share the results and information to other groups, so that each student can actively participate in the learning process. Students are able to share ideas and information in solving a mathematical problem so finding the right solution.

Based on the previous explanation, MMP and TSTS were the models and methods in the process of learning which provides the opportunity for students to improve the ability of its mathematical problem solving. This is supported by research conducted by Soviana (2013) entitled "*Keefektifan Pembelajaran Matematika Mengacu pada Missouri Mathematics Project terhadap Kemampuan Pemecahan Masalah Materi Segiempat Kelas VII SMP N 21 Semarang*" with results improving mathematical problem solving ability of students. In addition, research conducted by Dona (2012)

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CONCLUSION AND RECOMMENDATION

Conclusion

Based on the results of the study it can be concluded that: (1) Learning models Missouri Mathematics Project with Two Stay Two Stray methods effective in terms of mathematical problem solving ability of students. This is consistent with the results of the analysis of the data obtained $t_{count} = 7,171 > t_{(0,05:31)} = 2,0395$ and a significance level of less than 0,05 indicates that H_0 was rejected. It also means that the average score reached at least 75 in posttest based on KKM used in accordance with the school does not rejected. (2) There are significant differences between students' problem-solving abilities that learned with a learning models Missouri Mathematics Project with Two Stay Two Stray methods and students that learned with conventional learning models. This is consistent with results of data analysis showed that $t_{count} = 6,486 > t_{(0,05:62)} = 1,998971$ so H_0 rejected. Based on the analysis, it can be concluded that the learning models Missouri Mathematics Project with Two

Stay Two Stray methods affect the ability of students' mathematical problem solving.

RECOMMENDATION

Based on the research conclusions above, there are some suggestions that can be submitted are:

1. For Other Researcher

Another researcher who will perform research using learning models Missouri Mathematics Project with Two Stay Two Stray method can be done by adding variables and other matters with regard limitations and suggestions in this research so as to get better research results.

2. For School

Learning models Missouri Mathematics Project with Two Stay Two Stray method can be used as an alternative model of learning that can improve student math problem pemcahan SMP N 1 Tawangmangu.

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