The effect of Missouri mathematics project learning model on students’ mathematical problem solving ability

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Abstract. This research aims to know the influence of Missouri Mathematics Project Learning Model to Mathematical Problem-solving Ability of Students at Junior High School. This research is a quantitative research and uses experimental research method of Quasi Experimental Design. The research population includes all student of grade VII of Junior High School who are enrolled in the even semester of the academic year 2016/2017. The Sample studied are 76 students from experimental and control groups. The sampling technique being used is cluster sampling method. The instrument is consisted of 7 essay questions whose validity, reliability, difficulty level and discriminating power have been tested. Before analyzing the data by using t-test, the data has fulfilled the requirement for normality and homogeneity. The result of data shows that there is the influence of Missouri mathematics project learning model to mathematical problem-solving ability of students at junior high school with medium effect.

1. Introduction

Mathematics is known as queen of science because mathematics can generate other sciences such as physics, chemistry, geography and many other. Therefore, Mathematics science almost can be implemented in many field of life and even becomes one of the measurement of someone IQ.

There is a mathematics exam to measure the mathematics achievement of student aged 15 years, namely PISA (Program for International Student Assessment). PISA is a research program of once three years which aims to periodically do the research concerning the ability of student in reading literacy, mathematics literacy and science literacy. The ability of mathematics literacy in Draft Mathematics Framework PISA 2015 is defined as an individual’s capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain, and predict phenomena. It assists individuals to recognize the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens [1].

Therefore, PISA students must have the ability to formulate, apply, and interpret mathematics in various contexts and capabilities of mathematical reasoning and the use of concepts, procedures, facts, and mathematical tools to describe, explain, and predict phenomena. That ability is a basic ability that should have to be owned by the student of the participant of PISA to solve mathematics problem.

One of the key aspects assessed in PISA is the problem-solving ability because it is one of the high-order thinking skills assessed in PISA. This is consistent with the PISA mathematical problem which
examines three aspects: Content, Context and Competencies Cluster [2]. In this group of competencies PISA develops problem-based mathematical skills.

Indonesia is one of the countries which is included in PISA. However, if it is seen from the result of PISA, then the ability of mathematics literacy of Indonesian student is still low. This can be known from the achievement of Indonesia in following PISA in Indonesian literacy achievement in mathematics from 2003 to 2015.

| Year | Subject   | The average score of Indonesia | International Average Score | Rank Indonesia | Number of participant countries |
|------|-----------|--------------------------------|-----------------------------|----------------|--------------------------------|
| 2003 | Mathematics | 360                            | 500                         | 38             | 40                             |
| 2006 | Mathematics | 391                            | 500                         | 50             | 57                             |
| 2009 | Mathematics | 371                            | 500                         | 61             | 65                             |
| 2012 | Mathematics | 375                            | 500                         | 64             | 65                             |
| 2015 | Mathematics | 386                            | 500                         | 63             | 72                             |

The data in Table 1 shows that the students’ mathematical literacy skills are still very low when compared to other countries included in PISA. This means that the students mathematical problem-solving ability is still low. Therefore, the need for handling and improving the learning process in Indonesian students in terms of mathematical problem-solving skills is extremely urgent to improve the ability of Indonesian students’ mathematical literacy.

To have the ability of mathematics problem-solving is very important for the students. The importance of the ability of mathematics problem-solving for the student is also clearly emphasized by Branca [3], namely: (1) the ability of problem-solving is an important activity in mathematics learning even as the core of mathematics; (2) problem-solving can cover the method, procedure, and strategy or the way which is the core process in mathematics curriculum; and (3) problem-solving is a basic ability in mathematics learning. Similar with the view of Branca, Hartono [4] said that problem-solving is part of very important mathematics curriculum. Relevant to those two experts’ opinion, then the ability of mathematics problem-solving is a very important ability that student must have.

The choice of accurate learning model which is in accord with the objective of learning will help much and make the teacher easy in the process of learning in class. One of the learning models that can improve and develop the ability of mathematics problem-solving of the student is learning model known as Missouri Mathematics Project. That statement is relevant with the opinion of Dwiningrat, Suniarisih and Manuaba [5] who stated that one of the learning models that give a chance to the student to train and exercise the ability of problem-solving ability in mathematic problem-solving is learning model known as Missouri Mathematics Project.

Learning model of Missouri Mathematics Project is a learning model which consist of the steps of learning activities in systematic and structured steps along with the activities of student covering cooperative work and independent work and is ended by conclusion and assignment. Kismanto [6] said that learning model the so called Missouri Mathematics Project is one of the models being developed through the research and is a well-structured model. Steps of the Missouri Mathematics Project is review, development, cooperative work, seat work, and assignment.

This learning model is a combination of cooperative working with independent working, so that the ability of student to work together or to cooperate and to work independently can be trained well. In addition, added value of Missouri Mathematics Project is to bridge between teacher centered learning toward student centered learning [7].

Furthermore, Confrey gets the finding that the teacher who plans and implements five steps of mathematics learning will be more successful to be compared with those who use traditional method and approach [8]. The five steps are known as Missouri Mathematics Project which is proven to be more successful. Thus, in accord with the background presented above, the problem can be formulated in a question: Is there an impact of learning model of Missouri Mathematics Project toward the ability of
mathematics problem-solving of the student? Based on the formulation of the problem, then the objective of this research is to describe and analyze the impact of the learning model of Missouri Mathematics Project toward the ability of mathematics problem-solving of student.

2. Methods
This research is conducted in Junior High School in the even semester 2016/2017. Sample taking is conducted by using the method of cluster sampling. The sample being taken from this research are two classes namely one as an experiment class and another one is as a controlling class.

This research is using experimental method which is included as Quasi Experimental with the design uses is the static group comparison. The instrument being used in this research is the test ability of mathematics problem-solving of the student. The instrument being used in this research is the test of ability of mathematical problem-solving. Before the instrument is used to take research data, it should be tested to fulfill validity, reliability, level of difficulty and discriminating power as the condition of good instrument and the data being obtained is valid and not wrong. The result from the try out test of instrument, there are 7 reliable questions to be made as the data for the ability of mathematics problem-solving.

In accord with the precondition of the analysis, before the test of hypothesis (t-test), the test for fulfilling the requirement of analysis whose consists of normality test and homogeneity test should be conducted. The calculation of normality test in this research uses the test of Lilliefors at the level of significance of 5% with the criteria of normal distributed data test if \( L_{\text{result}} < L_{\text{table}} \). Homogeneity test in this research is using the test of Fisher at the level of significance of 5% with the accepted criteria of \( H_0 \) if \( F_{\text{result}} < F_{\text{table}} \).

After conducting analysis precondition test, hypothesis test is then conducted. To test formulated hypothesis, t-test statistical analytical is used with the test criteria of declining \( H_0 \) if \( t_{\text{result}} > t_{\text{table}} \). To know how big the impact of learning model of Missouri Mathematics Project to the ability of mathematics problem-solving of student is, the data is analyzed by using the formulation of effect size [9].

3. Results and Discussion
Result of analysis of post-test shows average score of the ability of mathematics problem-solving of different students between the experiment group and the controlled one. The different of average score is quite significance, the experiment group got average score higher than that of the control one. Average score of the ability of mathematical problem-solving data of the experiment group is \( \bar{X} = 46.39 \) whereas average score of the ability of mathematical problem-solving of the controlled group is \( \bar{X} = 33.68 \). This phenomenon shows that experiment group can do the post-test ability of mathematical problem-solving better than the controlled group can do.

Further, hypothesis test is conducted by using t-test. However, before doing t-test, analysis precondition test that consists of normality test and homogeneity test should be conducted.

The result of normality test and homogeneity test is as follows: Result of the calculation of normality test of the experiment group shows that experiment group distributed normally. This can be known from \( L_{\text{result}} = 0.1020 \) and \( L_{\text{table}} = 0.1437 \) so that \( L_{\text{result}} < L_{\text{table}} \). So is the result of normality test of controlled group distributed normally. This can be known from \( L_{\text{hitung}} = 0.1054 \) and \( L_{\text{table}} = 0.1437 \) so that \( L_{\text{result}} < L_{\text{table}} \). Furthermore, based on the calculation of homogeneity test of the experiment group and controlled group, the result obtained is \( F_{\text{result}} = 1.642 \). Whereas for value \( F_{\text{table}} \) at the significance level of 5% is 1.738. Thus, it can be concluded that \( F_{\text{result}} < F_{\text{table}} \). So that both groups can be said homogenous.

After conducting precondition test, the next test that can be conducted is hypothesis test (t-test). It is from the result of hypothesis test using t-test being conducted at the significant level of 5% the result obtained is \( t_{\text{result}} = 2.753 \) and \( t_{\text{table}} = 1.667 \). The following table presents the result of t-test calculation.
From Table 2 above, it can be known that $2.753 > 1.667$ so that, the obtained result is $t_{result} > t_{table}$ then it can be concluded that $H_0$ is declined. It means that there is a significant difference between experiment group and controlled one, namely the difference between student being taught by using learning model of Missouri Mathematics Project and student being taught not by using learning model of Missouri Mathematics Project. The existence of this difference proves that the implementation of learning model of the Missouri Mathematics Project has an effect on the mathematical problem-solving ability of students in class VII at Junior High School. Furthermore, from effect size calculation, effect size price is obtained (ES) for 0,725 then based on the valid criteria, effect size price is at the medium level.

The experiment group was being taught by using learning model of Missouri Mathematics Project with the following steps: 1) Review, students are reminded on the material lesson concerning rectangular and triangle having been taught at the elementary; 2) Development, students are given the new concepts and new ideas regarding the material that will be studied in the next session; 3) Cooperative Work, students are categorized into several groups and do the work sheet containing the problem of mathematics in group; 4) Seat Work, students are no longer sitting in group, students do the test being given by the teacher individually; 5) students are being given the homework as a routine exercise. Whereas the controlled group is not taught by using the learning model of Missouri Mathematics Project.

In the experiment group, students can learn in group and can discuss to arise their spirit and motivation to solve the problem in the work sheet being given by the teacher. Therefore, students are used to solving the problem and can develop their abilities in solving the problem. The result of post-test answer of the experiment group in a whole has fulfilled some indicators of the ability of mathematic problem-solving correctly, whereas the controlled group in a whole still cannot achieve the indicators of the ability of mathematics problem-solving correctly. Based on the explanation above, it can be concluded that there is an impact of learning model of Missouri Mathematics Project on the ability of mathematic problem-solving of students at $7^{th}$ grade.

### 4. Conclusion

Result of post-test data analysis of the ability of mathematic problem-solving of students being obtained shows that average score of the experiment group is higher than that of the controlled one. This phenomenon shows that the average ability of problem-solving of the students being taught by learning model of Missouri Mathematics Project is better than that of the students being taught not by learning model of Missouri Mathematics Project.

Both groups, the experiment group and the controlled one have fulfilled analysis preconception test which means that both data groups have distributed normally and are homogeneity. Further, hypothesis test is done by $t$-test. Based on the calculation of $t$-test that it is obtained that $t_{result} > t_{table}$ then it can be concluded that there is the influence of Missouri Mathematics Project Learning Model to Mathematical Problem-solving Ability of Students with medium effect.

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