The influence of Missouri mathematics project on seventh grade students’ mathematical understanding ability

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Abstract. Mathematical understanding ability is a primary goal of Indonesian national education goals. However, various sources has shown that Indonesian students’ mathematical understanding ability is still relatively low. This study used quasi-experimental research design to examine the effectiveness of the application of Missouri Mathematics Project (MMP) on students’ mathematical understanding ability. The participants of the study were seventh grade students in Pekanbaru, Riau Province, Indonesia. They were selected purposively and represented as high, medium, and low-quality schools. The result of this study indicated that there was a significant effect of MMP on the overall students’ mathematical understanding ability and in all categories, except for low school level.

1. Introduction
The learning strategy is needed to support all of the competencies that is contained in the Curriculum 2013. The curriculum comprises of what should be learned by students, while learning is how the lesson can be grasped by them. Every learning process must be accordance with the purpose of learning such as to develop students’ abilities. Therefore, all mathematics concepts should design to develop students' thinking ability. For example, the concept of arithmetic, geometry, and algebra are taught to develop students’ logic and thinking ability [5].

The development of students’ mathematical ability is very important in the learning process. The curriculum in Indonesia reveals the importance of developing students' mathematical abilities. One of the abilities that must be developed in learning is mathematical understanding ability [2]. Understanding ability is the lowest level in the cognitive aspects associated with the mastery or understanding. According to Skemp [2], the first ability to be developed is an instrumental ability, while the latter is a relational ability. The relational ability has a higher level than the instrumental understanding. Instrumental understanding and relational understanding need to be improved on mathematics learning. Previous studies indicate that Indonesian students’ mathematical ability in terms of instrumental and relational understanding is still low Priatna [8].

There are several factors that cause low achievement in mathematics. Mullis's study [2] explained that 7th grade students in Indonesian who participated in the competition were very weak in solving non-routine problems, both in solving problems about facts and procedures.

Then the results of study conducted by Sri Rezeki et al [8] on the implementation of learning activities in mathematics at Junior High School in Pekanbaru, it was found that many students who were
not interested in and not motivated to learn mathematics. It was obviously seen from the following students’ activities in the classroom:

1. Students tend to be more passive in classroom, just sitting down to take note what was described by teacher.
2. Students did not ask during learning process even though they didn’t understand.
3. Students did not do exercise.
4. Students were not interested in reviewing the previous knowledge that have been discussed.

In response to the above challenges, it should implement learning approaches that can motivate students to participate in learning so that their academic achievement, attitudes, and skills could be improved. Mathematics learning should be focused on developing students’ ability so that they will construct and apply their own knowledge actively. Teachers' responsibilities are not limited to prepare the lesson, but teachers should understand students’ characteristics to guide them in dealing with learning difficulties, especially in mathematics. To obtain an effective teaching learning process must be in accordance with the method to be used. This is supported by Ruseffendi who argued that in the process of learning mathematics there are ten factors that influence the success of children learn one of them is the model of learning presentation [6]. Not only method of learning also requires the creativity of teachers in presenting an effective learning. This is confirmed by Ruseffendi [2] who argued that one of the abilities that mathematics teachers should have in high school is to use various methods and teaching techniques during teaching.

Based on that case, it is necessary to apply a method that can improve students' mathematical understanding. Teaching model that can be implemented by teachers to improve it might vary, one of which is the Missouri Mathematic Project (MMP) model. Therefore, based on the above description, the study is focused on improving students' mathematical understanding through the model of Missouri Mathematic Project (MMP).

2. Methods
This research was a quasi-experimental research with nonequivalent control group design. The participants of the study was three junior high school students in Pekanbaru in the academic year 2015/2016 which were selected purposively. The selected school represented as high, medium, and low-quality schools.

3. Result and Discussion
The summary of descriptive statistics of students’ mathematical understanding ability before and after treatment across school quality is presented in Table 1. From Table 1, it can be seen that not all description of mean value of mathematical understanding of experiment class student is better than control class. The facts in the table above show that at the lower school level, the ability of the two classes looks the same on the pretest and posttest, both from the mean, standard deviation, minimum value, and maximum value. The high school level is also almost balanced for both classes.
Table 1. Descriptive statistics of students’ mathematical understanding ability across school quality

| Descriptive Analysis | Pretest | Posttest |
|----------------------|---------|----------|
|                      | Experiment | Control | Experiment | Control |
| Low School Level     |           |          |            |          |
| Number of samples (n) | 40       | 40       | 40         | 40       |
| Minimum Value        | 25       | 25       | 41         | 44       |
| Max Value            | 78       | 78       | 94         | 100      |
| Average (\(\bar{x}\)) | 45.90   | 41.73    | 77.50      | 70.70    |
| Standard Deviation (s) | 15.766 | 14.211   | 14.825     | 14.730   |
| Middle School Level  |           |          |            |          |
| Number of samples (n) | 42       | 42       | 42         | 42       |
| Minimum Value        | 38       | 33       | 50         | 54       |
| Max Value            | 83       | 88       | 100        | 92       |
| Average (\(\bar{x}\)) | 65.36   | 61.71    | 75.86      | 70.33    |
| Standard Deviation (s) | 12.024  | 13.793   | 12.830     | 10.902   |
| High School Level    |           |          |            |          |
| Number of samples (n) | 37       | 37       | 37         | 37       |
| Minimum Value        | 19       | 26       | 22         | 30       |
| Max Value            | 63       | 74       | 93         | 93       |
| Average (\(\bar{x}\)) | 42.27   | 44.62    | 69.81      | 62.62    |
| Standard Deviation (s) | 10.260  | 9.296    | 16.060     | 14.509   |

To ensure conclusion, this descriptive statistics will be followed by inferential statistics. The data analysis techniques performed in this study were similarity of two average tests for pretest values (2-tailed) and posttest value (1-tailed). To test the data hypothesis before to treatment, we first tested the homogeneity of variance to determine whether the experimental class and control class had homogeneous or non-homogeneous variances. The results are summarized in the Table 2.

Table 2. Homogeneity Test of Pre-test Score of Students’ Mathematical Understanding Ability across classrooms and School Categories

| School Level | Class | N  | sig  | Description | Conclusion   |
|--------------|-------|-----|------|-------------|--------------|
| Low          | Experiment | 40 | 0.241 | sig > 0.05 | Homogeneous  |
|              | Control  | 40 |      |             |              |
| Medium       | Experiment | 42 | 0.144 | sig > 0.05 | Homogeneous  |
|              | Control  | 42 |      |             |              |
| High         | Experiment | 37 | 0.273 | sig > 0.05 | Homogeneous  |
|              | Control  | 37 |      |             |              |

Based on the above table, it can be observed that the significance value of all school categories does not reject H0, the conclusion of the two groups at each level has a homogeneous variance. Because the experimental and control classes are homogeneous at each school level, then t-test is conducted to determine the ratio of prior knowledge before treatment between the experimental class and the control class. The results are summarized in Table 3.
Table 3. T-test of Pre-test Score of Students Mathematical Understanding Ability across groups and School Qualities

| School Quality | Class     | N  | S      | T_count | Sig (2-tailed) | Conclusion       |
|----------------|-----------|----|--------|----------|----------------|------------------|
| Low            | Experiment| 40 | 16.422 | 1.608    | 0.116          | H₀ is accepted   |
|                | Control   | 40 |         |          |                |                  |
| Middle         | Experiment| 42 | 15.819 | 1.492    | 0.143          | H₀ is accepted   |
|                | Control   | 42 |         |          |                |                  |
| High           | Experiment| 37 | 13.538 | 1.056    | 0.298          | H₀ is accepted   |
|                | Control   | 37 |         |          |                |                  |

Based on the above table, we get sig (2-tailed) > 0.05 for all school categories, so it is not reasonable to reject H₀, it means there is no difference in the average of initial knowledge of the experimental class with the control class. Acceptance of H₀ in pre-test data influence the next inferential test stages. The next step is mathematical understanding ability by school qualities based on MMP Learning (Experimental Class) and PK (Control Class) from post-test data. Beginning with the homogeneity test of variance data. The results are summarized in Table 4.

Table 4. Homogeneity Test of Post-test Scores of Students Mathematical Understanding Ability across groups and School Qualities

| School Quality | Class     | N  | Sig      | Description | Conclusion |
|----------------|-----------|----|----------|-------------|------------|
| Low            | Experiment| 40 | 0.706    | sig > 0.05  | Homogeneous|
|                | Control   | 40 |          |             |            |
| Medium         | Experiment| 42 | 0.469    | sig > 0.05  | Homogeneous|
|                | Control   | 42 |          |             |            |
| High           | Experiment| 37 | 0.460    | sig > 0.05  | Homogeneous|
|                | Control   | 37 |          |             |            |

From the above table, it can be observed that all posttest data of low, medium, or high-quality school have homogeneous variance. Therefore, testing the similarity of the two classes will continue on the t-test. The T-test was conducted to determine whether there was any effect of MMP model learning on mathematics comprehension ability at low, middle and high-quality school. In this study the T-test was calculated using the help of SSPS application version 16.0. The results are summarized in Table 5.

Table 5. T-test of Post-test scores of students Mathematical Understanding Ability across groups and School Qualities

| School Quality | Class     | N  | S      | T_count | Sig (2-tailed) | Conclusion |
|----------------|-----------|----|--------|----------|----------------|------------|
| Low            | Experiment| 40 | 21.328 | 2.016    | 0.051          | H₀ is accepted|
|                | Control   | 40 |        |          |                |            |
| Medium         | Experiment| 42 | 13.890 | 2.577    | 0.014          | H₀ is rejected|
|                | Control   | 42 |        |          |                |            |
| High           | Experiment| 37 | 20.218 | 2.163    | 0.037          | H₀ is rejected|
|                | Control   | 37 |        |          |                |            |
Based on the significance of the mathematical understanding ability of the experimental class and control class, for the high and medium-quality school accept H0, this means that there is an influence of students' mathematical understanding ability using MMP. While at low-quality school, there is no effect of mathematical ability of students who are exposed to MMP.

This case has been alluded by the descriptive data in Table 1. In low-quality school, the two classes are not much different, so it is natural that in the t-test this school quality data does not reject H0. While at other school quality, high-quality school is also almost not rejecting H0 and this has also been discussed descriptively in Table 1.

This finding is consistent with the research conducted by Anna Fauziah [3] in which the Missouri Mathematics Project (MMP) model had no significant effect on mathematical understanding. According to Fauziah this is possible because the structure of learning on the model of the Missouri Mathematics Project (MMP) is not much different from the usual mathematical teaching structure (SPM). This is in accordance with a theory proposed by Al Krismanto [1] who states that MMP is one of the structured model as well as with SPM.

Another possibility, there are still students who are not actively involved in learning and get confused when working on students’ worksheet, although at subsequent meetings they were faster in working on it. According to Slameto [7], students’ activeness in the learning process is one of the factors that can increase learning outcomes. Without students’ active participation in learning, learning process will not take place properly. In addition, for meetings 1 and 2, not all stages of the MMP model were implemented. This caused the project provided during the learning process was not performed well.

Nevertheless, researchers found that learning by using the Missouri Mathematics Project model (MMP) could lead students to work collaboratively with group so that it can facilitate students to understand and solve problems by discussing with their peers in group. If they do not understand the subject matter they can ask their group's friends and train students to account for their group's results. With this learning, students can ask and express their opinions without hesitation. This it will certainly have an impact on students' mathematics understanding skills. This is in line with Miftakhul Jannah et al. [4] who claimed that the Missouri Mathematics Project (MMP) learning model encourages students to cooperate, work on worksheets, and to help each other in order to deal with difficulties and exchange ideas. For students who have difficulty in asking teacher and difficulty in understanding the material being studied cooperative learning is very helpful.

4. Conclusion

Based on the results and discussion of the research, it can be concluded that there is significant effect of Missouri Mathematics Project (MMP) on mathematical understanding ability of seventh grade students from high and medium-quality school in Pekanbaru. However, there is significant effect of Missouri Mathematics Project (MMP) on mathematical understanding ability of seventh grade students from low-quality school.

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