The ability of mathematical problem solving of junior high school students in situation based learning and discovery learning

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Abstract. The ability of mathematical problem solving is needed in learning mathematics. However, the facts show that its is still low. This study aims to determine the achievement of mathematical problem solving abilities of students who obtains situation based learning model and discovery learning models. The method of this study was quasi-experimental study with a post-test only control group design. The subject of this research was 64 students in class 8\textsuperscript{th} of one junior high school in Garut, that was chosen by purposive sampling technique. The data was collected through the results of validated tests, interviews and observations. Mann-Whitney test was performed on quantitative data obtained, and description on qualitative data. The results show that the achievement of mathematical problem solving abilities of students who obtained situation based learning was no higher rather than students who obtained discovery learning. The causal factors because two models (1) are student-centered, (2) conducted in groups so that students can share strategies and information with their peers, (3) mathematical problem-solving questions are facilitated at each meeting, (4) have steps that support the use of indicators of problem solving ability in this study, (5) involve several factors that contribute to one's success in solving mathematical problems.

1. Introduction
One of the abilities must have for students are learning mathematics is the ability mathematical problem-solving. This ability is related to students' needs to solve the problems which be faced in their daily lives and be able to develop themselves. Therefore, the ability of problem-solving is becomes a special concern in process of learning mathematics at the level of formal education. This statement is supported by the National Council of Supervisors of Mathematics [1] that "learning to solve problems in the principal reason for studying mathematics" and the National Council of Teachers of Mathematics [2] that "problem-solving must be the focus of the curriculum".

The importance of this mathematical problem-solving ability is stated by [3] that problem-solving is at the heart of mathematics so it is necessary to develop mathematical problem-solving ability and find out the solutions to everyday problems. Mathematical problem-solving is an inseparable part of all mathematics learning and should not be isolated from mathematic programs. As the statement [4] that
Mathematics is a tool used to develop logical thinking, accuracy, spatial awareness to be able to solve challenging problems to improve students' mathematical abilities.

Mathematical problem-solving abilities of students can be interpreted as the ability to solve mathematical problems by using a solution strategy that contains the right steps. There are four indicators in mathematical problem solving ability that will be used in this study which are adapted from Polya's problem solving step [5]. First, understanding the problem to identifying information is known and is asked from the situation or problem. Second, choosing and compiling settlement plan to creating strategies are can be used. Then, the third is implementing the strategy and the fourth is re-testing the fact of the solution is obtained.

The urgency about the ability to solve mathematical problems is not in accordance with the facts found in the field which shows that the students' mathematical problem solving abilities are still not achieving satisfactory results. Research [5] shown that students' mathematical problem solving abilities are still relatively low, reaching only an average of 44%. This is in line with research conducted [6] which is stated that more students answered wrong rather than students who answered correctly, in the amount of 58.82% of students doing mistakes to solving problem-solving questions.

The application of an appropriate learning model can potentially develop students' problem solving abilities. One of them is the application of a model that requires students to be actively involved in learning and be student-centered. One of such learning model is situation based learning (SBL). SBL has the aim to develop students' abilities including problem posing, problem understanding, reasoning, communicating, and problem solving from a mathematical point of view [7]. SBL consists of four stages of learning process are creating mathematical situations, posing mathematical problems, solving mathematical problems, and applying mathematics. In all four stages, students are required to think.

Stage of creating mathematical situations, where the teacher presents a situation that is found in everyday life. Next is the mathematical posing problem, which is a stage where students and teachers jointly sort out which questions should be followed up. Then the mathematical problem solving stage, students will solve the questions that have been previously selected. At this stage students will be able to see the ability to solve problems. The last stage is applying mathematics, which is the stage where students apply the rules, concepts, or formulas found in the previous process to a new situation similar to the teacher presented.

Besides SBL there is another learning model that is also student-centered is Discovery Learning (DL). Stages that occur in the DL model are stimulation, problem statements, data collection, data processing, verification, and generalization [5]. Basically both SBL and DL are learning models that begin with a problem. However, in this DL model the problem has been determined in the worksheet unlike the problem in the SBL departing from a situation.

2. Methods
This research is a quasi-experimental study, with the design of this study is posttest-only control group design. So that in this study only one test is done at the end of learning. This test is conducted in two classes with five questions that have been validated beforehand. Questions on tests are adjusted with indicators of mathematical problem solving ability. In addition, interviews and observations were carried out to complement the results of the study. The population in this study were students in class 8th at SMP Negeri 2 Garut in the academic year 2019/2020. The subject of this research was 64 students in class 8th. Sample was chosen by the Purposive Sampling technique. Purposive Sampling technique is a sampling technique based on certain considerations [8]. The purpose of sampling like this is so that research can be carried out effectively and efficiently, especially in terms of supervision, the condition of the research subjects, the research time determined, the conditions of the study site and licensing procedures.
3. Result and Discussion

3.1. Result
This section will be explains the description and analysis of the results obtained by the research. The research began with a learning process in both classes, is used two different learning models. Then at the end of the study was done postes to see the achievement of mathematical problem solving skills in both classes. The following are examples of questions and answers to tests of mathematical problem-solving abilities provided by students in Figure 1.

Mr. Gege has a house with a rectangular pyramid-shaped roof with a base size of 6m x 6m and the height from the ceiling to the top of the roof is 4m. Mr. Gege will install the roof tiles on the roof of his house. Every $1 \text{ m}^2$ requires 16 tiles. If the price of a tile is Rp. 10,000, what is the minimum cost that Mr Gege has to pay to buy all the tiles needed?

Pak Gege memiliki sebuah rumah dengan atap berbentuk limas segiempat dengan ukuran alas 6m x 6m dan tinggi dari langit-langit ke puncak atap adalah 4m. Pak Gege akan memasang genting pada atap rumahnya tersebut. Setiap $1 \text{ m}^2$ memerlukan 16 genting. Jika harga sebuah genting Rp.10,000,00, berapa biaya minimal yang harus dikeluarkan Pak Gege untuk membeli semua genting yang diperlukan?

Figure 1. Examples of Answers of Ability of Students’ Mathematical Problem-solving Tests
Students who can solve these problems are 12 students from a total 64 students. It means that only 18.75% of students can complete these questions. Based on the question, students are expected to find the number of precarious needed by Mr. Gege to cover the entire building roof. However, students must first find out the height of the triangular roofs from the sides are already known. The picture above is an example of a student's answer that answers correctly and completely. Next, the following table is a description of the test results of the mathematical problem-solving abilities of the two classes.

| Data             | Situation Based Learning (SBL) | Discovery Learning (DL) |
|------------------|--------------------------------|-------------------------|
| X                | 69.88                          | 75.50                   |
| Sd               | 22.20                          | 16.62                   |
| Maximum Score    | 100                            | 100                     |
| Minimum Score    | 28                             | 40                      |

In Table 1, it can be seen average of posttest value of the mathematical problem solving ability of students implementing the SBL learning model is 69.88. Then the class that obtained DL learning had an average of 75.50. The table also shows the difference between the two average mathematical problem solving abilities is 5.62. The information states that the problem-solving ability of students who study in the SBL class is smaller than the DL class.

To see the achievement of this mathematical problem solving ability, an inferential statistical analysis was performed using the average difference test of the two classes. The hypothesis in this study is the achievement of mathematical problem solving ability of students who obtain learning with SBL models is higher than students who obtain DL learning. The formulation of the proposed statistical hypothesis is:

- $H_0$: $\mu_{SBL} \leq \mu_{DL}$ : The achievement of the mathematical problem solving ability of students who obtain learning with the SBL model is not significantly higher than students who obtain DL learning
- $H_1$: $\mu_{SBL} > \mu_{DL}$ : The achievement of the mathematical problem solving ability of students who obtained learning with the SBL model is significantly higher than students who obtained DL learning

With criteria:
- If the significant value $< \alpha (\alpha = 0.05)$, then reject $H_0$.

The following will be presented data on the results of the average difference in the ability to solve mathematical problems of the two classes using the Mann-Whitney test.

| Score Test                  |              |
|-----------------------------|--------------|
| Mann-Whitney U              | 453.500      |
| Wilcoxon W                  | 981.500      |
| Z                           | -0.787       |
| Asymp. Sig. (2-tailed)      | 0.431        |

Table 2 shown that the result of t-test was obtained 2-tailed significance value of 0.43, so that the significance value of 1-tailed becomes 0.22. In accordance with the testing criteria, meaning that the Sig. $> \alpha = 0.05$ so $H_0$ is accepted. So it can be concluded that the achievement of
3.2 Discussion

Based on Table 1 and Table 2, the conclusion is that acceptance occurs at $H_0$. The discrepancy of the hypothesis regarding the achievement of mathematical problem-solving abilities of SBL students is no higher than DL students with the results obtained allegedly caused by several things. Among them are the two learning models that require students to be actively involved in learning and discovering mathematical concepts learned through the problems presented in the worksheet. In theory, learning with the SBL model is able to encourage students to be actively involved in discussing and expressing opinions [7]. Through active student-centered learning will condition the active student in building his own knowledge with the teacher as a guide and facilitator. Such learning can improve student knowledge for the better [9].

The same thing is also in accordance with the statement [10] that by learning through experience, students can find, express and solve mathematical problems. In addition, this is in accordance with several studies [11,12] which state that SBL and DL have a positive contribution to the ability to solve mathematical problems. Similar to the statement [12] which states that there is no difference in the achievement of mathematical problem solving abilities for two student-oriented models. As a result there is no significant difference in the achievement of students' mathematical problem solving abilities with both models.

Besides, both learning are done in groups so that students carry out a process of discussion in groups so that students can share their thought strategies and information among their peers [13]. Mathematical problem solving itself has purpose to combine elements of knowledge, techniques, rules, skills and concepts that have been learned previously to provide new solutions [14]. This is in accordance with Vygotsky's theory that through socio-cultural aspects, students can more easily build their own knowledge. According to Vygotsky to build student knowledge scaffolding is needed from people who are more skilled in the student's environment, but it will be easier if the assistance comes from his peers.

Both of these models also direct students to solve problems so they can gain knowledge of the problems or situations encountered when learning takes place. Factors that influence the achievement of mathematical problem solving abilities are due to the steps of the two learning models. Both of these models have steps that support the use of indicators of problem solving ability in this study.

Another factor that causes the achievement of students' mathematical problem solving abilities SBL class is not higher than the DL class is that both classes are still facilitated with questions that can trigger the achievement of mathematical problem solving abilities. At the end of the meeting the researcher gives two to four questions which are sometimes used as quizzes for students to get students used to dealing with problems that are mathematical problem solving.

Then what causes the achievement of students' mathematical problem solving abilities SBL class is not higher than the DL class is that they both involve several factors that contribute to one's success in solving mathematical problems. There are several factors causing a person's success in solving problems such as deep mathematical knowledge, general reasoning, persistence, ability to organize groups and master heuristic strategies [15]. If this is well facilitated, then these factors can produce good problem solving skills so that it can have a positive impact on students.

4. Conclusion

Based on the results of the study, it was concluded that the achievement of mathematical problem solving abilities of students who obtained SBL was not higher than students who obtained DL. That is due to several factors, including the first because the two learning models are student-centered, second, in both classes conducted in groups so that students can share strategies and information with their peers. Third, in both classes facilitated mathematical problem solving questions at each meeting. Fourth, both models have steps that support the use of indicators of problem solving ability in this
study. Fifth, both of them involve several factors that contribute to one’s success in solving mathematical problems.

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Acknowledgments
Researchers say thank you to the parties involved, especially to the teachers and students at SMP Negeri 2 Garut.