

Students' Mathematical Problem-Solving Abilities Through The Application of Learning Models Problem Based Learning

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Abstract. One of the purpose mathematic learning is to develop problem solving abilities. Problem solving is obtained through experience in questioning non-routine. Improving students' mathematical problem-solving abilities required an appropriate strategy in learning activities one of them is models problem based learning (PBL). Thus, the purpose of this research is to determine whether the problem solving abilities of mathematical students' who learn to use PBL better than on the ability of students' mathematical problem solving by applying conventional learning. This research included quasi experiment with static group design and population is students class XI MIA SMAN 1 Lubuk Alung. Class experiment in the class XI MIA 5 and class control in the class XI MIA 6. The instrument of final test students' mathematical problem solving used essay form. The result of data final test in analyzed with t- test. The result is students' mathematical problem solving abilities with PBL better then on the ability of students' mathematical problem solving by applying conventional learning. It's seen from the high percentage achieved by the group of students who learn to use PBL for each indicator of students' mathematical problem solving.

1. Introduction

One of the objectives of mathematics learning is developing mathematical problem solving skills [2]. The ability to solve mathematical problems is the ability to use mathematics as a tool in solving various problems of everyday life. The importance of mathematical problem-solving skills is mastered by students because most components of the standard competency and basic mathematical competence have problem-solving abilities. This indicates that the students are not only learning about mathematical concepts or theories but must be able to solve the mathematical problems that require a skill. This is in line with the opinion that the essence of learning is problems solving [1]

Based on the purposes of learning mathematics, problems in mathematics there are routine or non routine problems. The non routine problem is a new problem for students, in the sense of having a different type of problems that have been known by students. According to Cooney et al that a question will be a problem only if the question indicates a challenge that can not be solved by a routine procedure known to the perpetrator [1]. This means that with the challenges and unknown routine procedures on a given question will indicate whether the question becomes a problem or not.

To solve the non routine problem, it is not enough for students to imitate how to solve problems that have been known, but the must make additional efforts. Good mathematical problem solving skills will allow the student to be able to solve the problems that exist in everyday life gained through their experiences [4]. Various research show that children who are given a lot of practice in problem



solving have high test scores compared to children who were given little practice. It was also mentioned by Capper that previous student experiences, cognitive development, and interest in mathematics were factors that greatly influenced success in problem solving [3].

Gagne also said that "high-level of intellectual skills can be developed through problem solving" [3]. This is because that problem solving is an attempt to find a way out of a difficulty in order to achieve goals that are not so immediately achieved. When student solving math problem it is possible to use the knowledge and skills already possessed to be applied in solving the problems. Therefore, by familiarizing to practice the students their problem solving ability in mathematics can improve the ability to think carefully, logically, critically and creatively to develop students' intellectual ability. In order for students to have good problem solving skills, it is necessary to designed learning that can increase the students' interest to try and to solve the given problems. One of them with Problem Based Learning (PBL) learning model. PBL learning model can be applied to learning mathematics to improve the ability of creative thinking and problem solving skills in students.

PBL is a learning that exposes students to practical problems as a foothold in learning or in other words students learn through problems. The syntax of PBL learning model consists of 5 phases: (1) student orientation to the problem, (2) organizing students to learn, (3) guiding individual and group investigation, (4) developing and presenting the work, (5) analyze and evaluate the problem-solving process. In the application of PBL learning model is used scientific approach.

The scientific approach is a science-based approach and requires students to be more active in the learning process. The steps of learning with the scientific approach are basically based on the facts of the observed object, namely (1) observing facts or phenomena; in this stage students seek information, see, hear, read, and listen; (2) asking to build knowledge, this stage is done through discussion and group work; (3) attempts to strengthen students' conceptual understanding, this is done through planning, designing, and executing experiments, and obtaining, presenting, and processing (4) reasoning data that enables students to think critically. PBL is a learning model designed in which students work on authentic issues with the intent to structure their own knowledge, develop inquiry and high-level skills, develop independence and trust. The learning model is based on problems that require real investigation and resolution so that students are encouraged to solve problems by expressing their ideas or ideas in classroom discussions.

This is in line with a scientific approach that requires students to actively construct concepts, laws or principles through observing stages (for identifying or formulating problems), proposing or formulating hypotheses, collecting data with various techniques, drawing conclusions and communicating concepts, laws or principles the "found". The application of a scientific approach to learning involves the process of observing, questioning, reasoning, trying and communicating.

Stages of PBL learning with a scientific approach in phase (1) stage of the problem is to orient students to the problem, the teacher raises real questions in the student environment and investigated by students. Presenting certain phenomena or demonstrating an event arouses students' curiosity by giving students the opportunity to observe through viewing, listening, listening and reading activities. Teachers guide students to be able to ask questions about the problems presented, (2) the stage of organizing students to learn. Learning based on this problem students work together with each other in small groups so that teachers can guide students to be active in the group in solving the given problem. Working together to engage and to exchange ideas can train students' ability to ask questions and to communicate their ideas. Phase (3) stage guiding individual and group investigation. In this phase teachers encourage students to collect data and carry out experiments until they understand the issues and concepts or approaches and strategies used to solve the problem. The goal is for students to collect enough information to create and build their own ideas to solve problems. Questioning and associating activities strongly support the success of this phase, (4) the stages of developing and presenting the work. At this stage students write down the problem solving of a series of information that has been obtained. A series of concepts are collected in group activities and selected appropriate strategies and approaches in problem solving. In this phase the activities of trying, reasoning and communicating are highly demanded in the problem-solving process, (5) the stage of analyzing and evaluating the

problem-solving process. This phase is intended to give students an opportunity to analyze and evaluate their processes and inquiry skills with the knowledge they use. The teacher's job in this phase is to guide and assist students in the investigation in the processes they use. The purpose of the study is to determine whether the mathematics problem solving skills of students who learn to use PBL better than the students who learn to use conventional learning in class XI MIA SMAN 1 Lubuk Alung.

2. Method and Design

This is a quasi-experimental study using two sample classes of experimental class and control class. The experimental class, applied the problem based learning model and the control class applied conventional learning model. To obtain the sample class the assumption test has been tested the test is the average equality with one way anova statistical test. This average equality test is performed after the assumption test of normal and homogeneous population distribution data. The experimental class is represented by the students of class XI MIA 5 and the control class is represented by class XI MIA 6 of six MIA population class SMAN 1 Lubuk Alung.

To obtain the data of research results used tests based on mathematical troubleshooting indicators is tested. Mathematical troubleshooting indicators include: organizing data and selecting relevant information; presents a problematic formula mtematically; choose and use the right approach or strategy; solve the problem; interpret the results of the answers obtained. Assessment used scoring rubrics with a score of 0 to 4. Five problem are made based on validation by some people who are experts in their field. The problems that have been used was tested in another schools that have characteristics similar to the research school. Analysis of test results is done by examining the differentiation and difficulty index questions. The results of the analysis show that all questions can be used. Data analysis one way t test with significancy level 0,05.

3. Result and Discussion

Based on the result of math problem solving test, the average score of the experimental class is 82.29 and the control class is 70.27. This indicates that the average of the experimental class is higher than the average of the control class. The standard deviations of each experimental class and control class are 10.45 and 12.25. Based on standard deviation results can be stated that the ability of solving experimental class math problems more uniform than the control class. The data analysts were performed using the t-test after the normality and homogeneity tests of both sample classes were met. The result of t-test data analysis on the real level of 0.05 shows that the average problem solving ability of experimental mathematics class is higher than the control class. This shows that the experimental class is better than the control class.

The PBL learning model begins by presenting real problems whose solutions require cooperation among students. This learning helps students to process the received information to be processed in their thinking and then develop their own knowledge to solve the problem. The facilitator guides every investigation undertaken by students from analyzing and defining problems, collecting and analyzing information, conducting experiments and formulating conclusions.

The application of the five phases of PBL is done in the experimental class, where the phases can support to improve students' mathematical problem solving skills. Phase to (1) orient the students to the problem so that students can observe problems related to the material to be studied together. In this phase students are stimulated by their curiosity questions or raises allegations so that students can investigate directly the information needed to answer these allegations.

Phase (2) organizes students to learn. In this phase students are organized to study in the form of small group discussions. In its implementation within the group, the student sets out a chairman and a notary who will record any ideas deemed appropriate in solving the problems on the worksheet. The chairperson also mediates in the event of a disagreement between the members of the group. In this phase students are given the opportunity to ask about work sheets. Then through question and answer activities students are directed to recall the material that has been studied to be able to solve the problem. Phase (3) guides individual and group investigations. Students are given guidance to

investigate the problems given to the worksheet. The guidance includes the collection of information relating to the material to be discussed. Students in his group conducted experiments in solving the problem. Phase (4) develops and presents the work. In this phase after the students collect the information needed to solve the problem then the students develop the information, and choose the right solution to solve the problem. Then the selected group presented the results of the settlement that had been discussed. The last phase is the phase to (5) analyze and evaluate the problem-solving process. The facilitator with the students analyzes and evaluates the problem-solving process presented by the group as well as the entire learning activities undertaken. In this phase the facilitator provides strengthening related to the mastery of knowledge.

The five phases in the PBL can support and develop students' mathematical problem solving ability, it is because learning using the PBL model makes it a real problem as a trigger for student learning before they know the formal concept. Students will critically identify relevant information and strategies and conduct investigations to resolve the issue. By solving the problem students gain or build on certain knowledge and at the same time develop critical thinking skills and skills in solving problems. Stages of PBL are done systematically and integrated with scientific activities can develop the ability of learners in solving problems and simultaneously can master the knowledge in accordance with the basic competencies to be achieved.

Based on the results of this study can be stated that the ability of problem solving mathematics students learning applied PBL learning model is better than the problem solving skills of students who learn mathematics with conventional models. This is shown from the results of student final tests based on mathematical problem-solving indicators.

Percentage of students' test on problem solving test based on indicators for experimental class were 92%, 90%, 83%, 74%, 65%, respectively. The control classes are 87%, 80%, 72%, 57%, 52%, respectively. The percentage of acquisition of the two sample classes based on this indicator shows that the percentage of mathematical problem-solving abilities for each indicator of the experimental class is higher than the control class. The descriptions of the results of the mathematics problem-solving test are described as follows.

3.1 Organizing Data and Selecting Relevant Information

After analyzing the student answer sheets in the two sample classes, the data obtained results of students' ability in organizing data and selecting relevant information to the given problem. The percentage score of the students' experimental class ability in achieving the indicator is better than the control class. For each item the percentage of scores obtained by the experimental class in achieving the indicator is higher than the control class. The result of the percentage score of students ability for item 1 to 5 for experimental class is 91%, 89%, 93%, 92%, 94% and control class 89%, 83%, 88%, 86%, 89%.

3.2 Present a Systematic Problem Formulation

The result of the final test of the students' mathematics problem solving ability, the percentage score of students ability in presenting systematic problem formulation for the experimental class is 89%, 83%, 92%, 91%, 92% and control class is 76%, 76%, 83% , 77%, 87% Percentage score of students' ability in presenting a problem formulation in experimental class is better than control class. For each item, the score obtained by the sample class has a higher percentage than the control class.

3.3 Selecting and Using Appropriate Approaches and Strategies for Solving Problems

The results of the analysis obtained by the students for the percentage of students' ability score in choosing and using approach and strategy in solving the problems for experimental class are 85%, 73%, 85%, 83%, 83%, 87% and control classes respectively 70% , 64%, 79%, 68%, 81%. The result of the percentage of students' ability score in experimental class in choosing and using the appropriate approach and strategy is higher than the students in the control class. This suggests that the ability of the experimental class is better than the control class in mathematical problem solving.

3.4 Solving Problem

Based on the data of the final test analysis of students' mathematical problem solving ability in the sample class in the problem solving indicator, the score of students' ability in the experiment class is better than the control class. This can be seen from the five items of the experimental class obtained a higher percentage than the control class. Obtaining the experimental class is 73%, 68%, 73%, 77%, 78% and control classes are 60%, 50%, 58%, 49%, 67%.

3.5 Interpreting the Results of Answers Obtained

Based on the results of the analysis of the student answer sheets for the experimental class were 61%, 56%, 64%, 68%, 76% and control classes were 56%, 45%, 52%, 47%, 59%. This suggests that the ability to solve mathematical problems to estimate the results of the answers obtained in the experimental class is better than the control class.

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