Improving the Students' Mathematical Problem Solving Ability by Applying Problem Based Learning Model in VII Grade at SMPN 1 Banda Aceh Indonesia

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Abstract: One of the relevant strategies to improve students' mathematical problem solving is problem-based learning model. Problem based learning has a positive effect on the improvement of students' mathematical problem solving ability. This study aims to determine the increase in mathematical problem solving ability of students taught with problem-based learning model is better than the increase in mathematical problem solving ability of students taught by conventional teaching. Research conducted in the form of quantitative research with experimental approach to *true experimental* designrandomized control group pretest-posttest. The research sample was determined by random technique that became the experimental class (VII_7) and the control class (VII_8). The test results of quantitative data shows that the normal distribution of data, which can be analyzed by statistical one sample t-test at α = 0. 05 significances, based on data analysis of N-Gain score of mathematical problem solving ability obtain $t_{calculated}$= 3. 7 dan t_{tabel} = 1. 67 or$t_{calcuate}$>$t_{tabel}$is 3. 7 > 1. 67, it means that $H_0$is rejected and consequently H_1 is accepted. From the results of this study concluded that the increase in mathematical problem solving ability of students who received application of problem-based learning model is better than students who received conventional learning the material opportunities.

Keywords: Problem Based Learning, Problem Solving Ability, Opportunity, Gain Normalized.

I.   INTRODUCTION

Mathematics is one of the subjects that occupy an important role in education. There are many reasons on the need for students to learn mathematics one of them according to Cockroft in Abdurrahman (2003) [1] says that mathematics should be taught to students because: (1) is always used in our life, (2) all of subject study require math skills appropriate, (3) a means of communication that is strong, short, and clear, (4) can be used to present information in a variety of ways, (5) improve the ability to think logically, accuracy, and awareness of spatial, and (6) give satisfaction to the efforts to solve problems challenge. Various reasons for the need of the school teach mathematics to students in essence can be summarized as problems of everyday life. Mathematics is one way to train students to think in ways that are logical and systematic way to solve mathematical problems.

The ability of mathematical problems solvingis very important for solving the problem is a general purpose of teaching mathematics even by Branca (Sugiman & Kusumah, 2010) [2] interpreted solving problem in three things: solving the problem is seen as a destination (a agoal), a process, and a basic skills. Problem solving in mathematics can be interpreted as: math learning goals concerning the reasons why math is taught, the process of applying knowledge previously obtained into a new and unknown situation, and basic skills are: minimal skills in evaluation. Thus solving the problem is

not just a goal of learning mathematics but also a major tool to perform or work in mathematics. But in fact this time is the problem solving ability of students in mathematics learning is low and needs to be improved, based on research results Eviyanti & Surya (2016), [3] "mathematical problem solving ability of students is low based on the analysis of student test results on the materials of opportunity".

One of learning model that can enhance the problem solving ability is a Problem-Based Learning (PBL) model. Education learning with problem-based learning helps students to demonstrate and clarify ways of thinking as well as the richness of the structures and cognitive processes involved in it. PBL optimize goals, needs, motivations that drive a learning process of designing various kinds of cognition troubleshooting. Arends (2009) [4] states that *"problem-based learning helps students develop Reviews their thinking and problem solving skills, learn authentic adult roles, and Become independent learners.* "It was a problem-based learning helps students to develop thinking skills and problem solving skills, learn the roles of adults, and become independent learners. In this case the problem-based learning helps students to process information in his mind and prepared their own knowledge. In addition, students are also trained to grow up and become independent learners in daily life.

II. PROBLEM SOLVING ABILITY

In general, the problem is the gap between expectations with reality, between what they want or what is intended with what is happening or facts. A problem usually contains situations that encourage someone to solve it, but do not know firsthand what is to be done frist to solve them. To obtain the ability in problem solving, one must have a lot of experience in solving various problems. A question or a math problem is said to be a problem if the solution requires some creativity, understanding and thinking / imagination of everyone facing the problem. The mathematical problem is usually a matter of the story, proving, create or find a mathematical pattern. According to the NCTM (2000) [5] that the problem-solving ability is not just a goal of learning mathematics but also a major tool to perform or work mathematically. According to Pehkonen (2007) [6], "*problem solving has been one of the general goals overall in the Finnish curriculum.* ".

There are many interpretations about problem solving in mathematics. Among these Polya opinion is the most referred by manymath observers. Polya define that problem solving interpret as an attempt to find a way out of a difficulty to achieve a goal that is not so immediately achievable. Math problems as a challenge when need a solution requires creativity, understanding and original thought or imagination. Therefore we can conclude that problem-solving is the ability to knowledge in each person that in the solution varies depending on what is seen, observed, in mind and in their minds according to the incident in real life.

By Polya (1973) [7] there are four steps in solving the problem, namely: (1) understand the problem: in this activity is to formulate: what is known, what is asked, whether the information sufficient, condition (condition of) what should met, restate the original problem in a more operational (solvable). (2) planning the solution: the activities carried out in this step is trying to find or recall issues you've solved that has similarities with the properties that will be solved, look for patterns or rules, draw up resolution procedures. (3) implement the plan: the activities in this step are performs the procedures that have been created in the previous step to the settlement. (4) to re-examine the procedures and results of the settlement: activities in this step is analyzing and evaluating whether the procedures applied and the results obtained are correct, whether there are other procedures that are more effective, whether procedures have created can be used to solve similar problems, or whether the procedures generalizations can be made.

According to the NCTM in Posamentier and Krulik (2009) [8], the problem solving is the important part of the math curriculum because in the learning process and student completion is possible to gain experience using the knowledge and skills already possessed to be applied to solving the problem.

III. PROBLEM BASED LEARNING MODEL

PBL is not a new phenomenon. According to Boud and Feletti (Nazir, 2010) [9] PBL is a methodology that will be used before the classroom concepts are introduced. PBL curriculum as a core in this research was introduced by Howard Barrows (medical education level, McMaster University) and the origin of PBL can be traced to the progressive movement, especially to John Dewey"s belief that teachers should teach by appealing to the students" natural instincts to investigate and create.

In general, problem-based learning is a learning model that uses real-world problems as a context for students to learn about critical thinking and problem solving skills, as well as to acquire knowledge and essential concept of learning materials. According to Sanjaya (2010) [10] defines " problem-based learning model can be interpreted as a series of learning activities, with emphasis on the process of resolving the problems faced scientifically".

Moffit in Rusman (2011) [11] says that the problem-based learning is an approach to learning that uses real-world problems as a context for students to learn about critical thinking and problem solving skills as well as to acquire the knowledge and concepts are the essence of the subject matter.

In the process of learning and problem solving, students can gain experience using the knowledge and skills already possessed. This experience is then trained students into logical thinking, analytical, systematic, critical, and creative in dealing with problems.

In problem-based learning students are required to solve the problems presented by digging as much information. This experience is indispensable in daily life where the development of thinking and one's work depends on how he teaching himself. In essence, problem-based learning is a learning that uses real-world problems presented in early learning. Then the problem is investigated to know the solution of solving the problem.

Problem-based learning requires students to actively think, communicate, and process the data, and finally concluded. Learning activities directed to solving problems, problem solving is done by using an approach to think scientifically.

Step-by-step implementation of problem based learning model, namely: (1) the orientation of the problem: in this step the teacher explains the purpose of learning, motivate students, (2) organize the students to learn, (3) To lead the investigation of individuals or groups, (4) Develop and presents the results of the work, (5) analyze and evaluate the process of problem solving.

Theoretically the problem-based learning has several advantages that problem based learning model engages students in learning activities so that knowledge really absorbed properly, these models make students actively solve problems and require thinking skills students are higher so that students can experience the benefits of learning mathematics because the problems are solved daily life problems.

This is in accordance with the opinion ofthe Wee and Kek in Amir (2010) [12] says some of the advantages of problem-based learning model, as follows: 1) Have an authenticity like in the job world;2) Built by taking into account prior knowledge;3) To develop metacognitive thinking and constructive. Metacognitive means to try to reflect what we thought on one thing;4) Increase the interest and motivation in learning. With the interesting problem design and challenging problems, learners will be inspired to learn. When high relevance to day practice, usually the learners will be stimulated curiosity and determined to solve the problem. It is expected, that had been classified as passive learners may be interested to be active.

Advantages of problem-based learning (Akinoglu, 2007) [13] Classes are student-centered instead of beingteacher-centered. 2) This learning model develops self-control instudents. It teaches making plans prospectively,facing realities and expressing emotions. 3)This model enables students to see events multidimensionallyand witha deeperperspective. 4) It develops students' problem-solving skills. 5) It encourages students to learn new materialsand concepts when solving problems. 6) It develops sociability levels and communicationskills of students by enabling them to study andwork in a team. 7) It develops students' high level thinking/criticalthinking and scientific thinking skills. 8) It unites theory and practice. It allows studentsboth to merge their old knowledge with newknowledge and to develop their judging skills ina specific discipline environment. 9) It motivates learning for both teachers andstudents. 10) Students acquire the skills of time management,focusing, data collection, report preparation andevaluation.

IV.   RESEARCH METHODS

The research was conducted in SMP Negeri 1 Banda Aceh, located on Jl. Prof. A. Majid Ibrahim 1, Banda Aceh. The reasons for the selection of SMP Negeri 1 Banda Aceh due to the lack of research on problem solving capabilities to do in junior high school. Research conducted in the form of quantitative research with *true experimental design* approach to *randomized control group pretest-posttest*designs. The research sample was determined by random technique that became

the experimental class (VII$_7$) and the control class (VII$_8$). The data that collecting in this study is mathematical problem solving ability data by using instrument in the test to be prepared, measure the validity criteria before the test using as intruments data collecting, by obtain that the data accurated. The author conducted consultations with counselors and teachers of mathematics in the study. This is done to meet the theoretical validity of the instrument.

The test in this study name by *pre test*(before treatment) and *posttest* (after treatment). The eachtests consist of five objective questions to determine how the students' mathematical problem solving ability.

Researchers conducted five meetings, one time pre-test, three times studying with PBL models for experiment classand conventional classes for control class and 1 post-test to obtain data. *Pre test* and *post test* given to all studentsin experimental class and control class. *The* results of *pre-test* and *post-test* were used to determine the increase in mathematical problem solving ability of students to the opportunity material.

After the data has collected, the data will be processed and analyzed by using statistical formulas manually and *Microsoft Office Excel 2010.* Comparing the scores of pre-test and post-test to look for an increase (gain) that occurs after learning in each group were calculated as normalized gain Hake (2007) [14] namely:

$$g = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}} \ \dots\dots\dots\dots\dots\dots\dots\dots \tag{i}$$

Description:

g : Normalized Gain Score

S_{post} : *post-test*score

S_{pre} : *pre-test* score

S_{maks} : Maximum Score

The result of the calculation of the average value of N-gain is then interpreted using the following classifications.

Criteria table of *N-Gain*

N-Gain	Interpretation
0. 7 *g*	High
0. 3 *g* <0. 7	Moderate
g <0. 3	Low

(Source: Hake, 2007) [14]

Hypothesis testing using one sample t-test through gain score of mathematical problem solving ability to know the difference improving of students' mathematical problem solving between control class and experimental class by $\alpha = 0{,}05$ significance. The test are averages of μ_1 and μ_2, match null hypothesis and unmatchable is:

H$_0$: $\mu_1 = \mu_2$ There is no difference between the increase in mathematical problem solving ability of students to use problem-based learning model with an improving in mathematical problem solving ability of students who use conventional learning

H$_1$: $\mu_1 > \mu_2$ The increase in mathematical problem solving ability of students to use problem-based learning model is better than the increase in mathematical problem solving ability of students who use conventional learning

Because the test used is the right hand, then the applicable test criteria is rejected H_0 if t $>t_{1-\alpha(n_1+n_2-2)}$ and accept H_0 if t have other prices, with degrees of freedom dk $= n_1 + n_2 - 2$and opportunities $(1 - \alpha)$. If the data is not normally distributed, then the hypothesis will be tested by non-parametric statistical tests. The test used is the Mann-Whitney test. According Sundayana (2010) [15] Mann Whitney test was used to test differences in the average of the two sample groups independent if one or both groups of samples are not normally distributed.

V.   RESEARCH RESULT

The data obtained in this study is derived from the *pre-test* and *post-test* on the subject of opportunities. The mathematical problem solving ability scores obtained from the administration of the test can be seen from the presentation of the data below.

a. Experiment Class (VII$_7$):

• Mathematical problem solving ability *pre-test* score

48	40	40	50	45	46	36	40	44	36
46	42	44	48	46	31	50	42	44	56
46	46	38	47	43	40	57	34

• Mathematical problem solving ability *post-test* sscore

92	70	95	96	65	94	79	75	91	91
69	85	84	98	92	83	63	90	96	95
95	71	76	81	88	90	94	94

b. Control Class (VII$_8$):

• Mathematical problem solving ability *pre-test* score

38	41	53	42	40	44	37	40	45	37
37	41	46	46	46	36	43	51	48	45
42	44	36	42	42	42	22

• Mathematical problem solving ability *post-test* sscore

66	69	91	88	83	80	60	85	79	66
50	75	48	70	93	54	84	83	80	51
87	87	40	72	75	86	28

The quantitative test result show that the data has normal distribution, which can be analyzed by statistic one sample t-test against the gain score of mathematical problem-solving ability to know the difference of impriiving students' mathematical problem solving ability between the control class and experimental class at α = 0,05 significance. Based on the analysis of the mathrmatical problem solving ability *N-Gain* scoreis obtained t_{count} = 3. 7 and t_{table} = 1. 67 or t_{count} >t_{table} ie 3. 7> 1. 67, , that means H$_0$ is rejected and consequently H$_1$ accepted. The meaning can be concluded that the improved in mathematical problem solving ability of students to use problem-based learning model is better than the improving in mathematical problem solving ability of students who use conventional learning.

VI.   RESEARCH DISCUSSION

Based on the analysis that has been done, it can be seen that there are differences in problem solving capabilities improve significantly between students who received problem-based learning (class VII$_7$) and students who only received conventional learning (class VII$_8$). This is evident from the average N-Gain score mathematical problem solving ability both classes for the opportunity materials. *N-Gain* score the ability of mathematical problem solving in students experiment resulted in the average value of 0. 74 into the improve category of "high", while the control group reached an average value 0,52 into the improve category of "medium", it is clear that with based learning the problem of improving students' mathematical problem solving ability is better than conventional learning. This is consistent with Padmavaathy and mareesh (2013) [15] in his research entitled "Effectiveness of Problem Based Learning In Mathematics". Showed that problem-based learning is more effective for teaching mathematics. And according the opinion Saragih & Habeahan (2014) [16] in they research show *"To improve of mathematical problem-solving ability of students who are taught*

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through PBL has average 0. 7675 higher than students taught through CL with average 0. 2973 at significant rate of 0. 000". And John T. Ajai. et al (2013) [17] in his research showed that students taught using problem-based learning is achieved is significantly higher than those taught using the usual learning.

Theoretically the problem-based learning has several advantages that problem based learning model engages students in learning activities so that knowledge really absorbed properly, these models make students actively solve problems and require thinking skills students are higher so that students can experience the benefits of learning mathematics because the solved problems are daily problems. ev

VII. CONCLUSION

Based on the results of research and discussion, it can be concluded that there are differences in the improve in mathematical problem solving ability of students who received the application of the model of problem-based learning and students who received conventional learning in the opportunities material in class VII SMP Negeri 1 Banda Aceh. The difference is the improved in mathematical problem solving ability of students through problem-based learning model is better than students who received conventional learning.

VIII. SUGGESTION

From the research that has been obtained, it can be stated that learning to apply problem-based learning model is a positive influence on students compared to conventional learning, so that researchers can provide suggestions as follows::

1) Application of problem based learning model is expected to be used as an alternative in the process of learning mathematics in junior high school, because this learning model can improve students' mathematical problem solving ability is certainly an impact on the outcome of the mind and problem resolution.

2) It is expected that other researchers to conduct research on a similar but different material and other aspects in the study of mathematics as a point of comparison with the results of this study.

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