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RESEARCH ARTICLE

Developing PBL To Improve Mathematical Problem Solving And Self Efficacy

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ABSTRACT

This study is a research development (R&D) that aims to find out developing Problem-Based Learning (PBL) to improve students' mathematical problem solving abilities and valid, practical and effective student self-efficacy. The procedure of this research uses research development by Borg & gall, Research and Information Collecting, Planning, Developing Preliminary of Products, Preliminary Testing ,Main Product Revision, Main Field Test, Operational Product Revision, Operational Field Testing, Final Product Revision, Dissemination and Implementation, but in this study it was carried out only to the sixth stage. Data collection techniques using observation, interviews, questionnaires, and tests. The design is validated by the learning model design expert, while the learning device is validated by the material expert, media expert and education practitioner. Furthermore the design was revised according to expert opinion. It was concluded that the ability to solve mathematical problems and self efficacy with problem based learning is more effective than the ability to solve mathematical problems with conventional learning.

1. INTRODUCTION

Mathematics is one of the subjects that is able to be used as a means of achieving educational goals, according to Soedjadi (2000) the general goal given mathematics at the level of basic education and general education is to prepare students to be able to face changes in circumstances in life and the developing world, through training act on the basis of logical, rational, critical, careful, honest, effective, and efficient thinking, and prepare students to be able to use mathematics and mathematical thinking patterns in daily life and in learning science.

But in reality at this time mathematics education in schools in particular, is still a problem that is difficult to be solved by both students and teachers. This is because the study of mathematical objects that are abstract. In line with Ruseffendi (Herman: 2008) which states that mathematics is a symbol of deductive science that does not accept evidence inductively, the science of orderly patterns, and organized structures, ranging from unorganized elements, to axioms or postulates, and finally to the proposition. So mathematics is difficult to understand by students which results in students' lack of interest in solving it and becoming a scourge of their own.

The form of the problem faced by the teacher is how the teacher can provide learning materials effectively and efficiently so that students are able to absorb the maximum material provided by the teacher. In practice, transferring experiential knowledge and ideas (ideas) from the teacher to students is not easy to make what is taught can be absorbed, understood, and lived. This can be seen from the results of learning mathematics obtained by students after participating in mathematical evaluation activities given to students so that they have a systematic and rational mindset, which can be applied in everyday life.

Furthermore, the problems present in learning come from students where the conditions and atmosphere in the learning process of students tend to be less active in learning, there are several factors that enable students to experience inactivity in the classroom including students' lack of understanding of the ongoing material, lack of student interest in following the lesson which is associated with students' disinterest with the delivery of material that is too monotonous, teacher center or based on what the teacher conveys and the lack of variation in learning, students only understand the delivery delivered by the teacher, as well as the lack of self-confidence of a student in the learning process which makes its own influence on each student. From these factors, methods are needed that can help students to understand the material delivered by the teacher, so that learning is more effective and students get maximum results in learning evaluation

One of the lessons that can be applied is problem based learning that is problem based learning where students will be given several daily problems and problems around them related to the material to be discussed by the teacher so that students can understand the existing problems. The problem-based curriculum gives students a guided experience in learning through solving

complex real-world problems. PBL was designed with several important goals Barrows and Kelson (1995) including to help students build a broad and flexible knowledge base, develop effective problem solving skills, develop lifelong learning abilities, be knowledgeable, be effective collaborators, and be intrinsically motivated to study.

Strategies for solving problems can be taught first before problem solving learning is carried out. One method of teaching that can be implemented is the problem based learning model. Problem Based Learning is a teaching method that is characterized by the existence of real problems as a context for students learning critical thinking and problem solving skills, and gaining knowledge of Duch (1995). Problem Based Learning Model is a learning model with a student learning approach to authentic problems so students can organize their own knowledge, develop higher skills and inquiry, independent students and increase self-confidence Arends (Abbas: 2000: 13).

This model is characterized by the use of real life problems as something students must learn to practice and improve problem solving and gain knowledge of important concepts, where the teacher's task must focus on helping students achieve self-directed skills. Problem Based Learning or problem based learning includes asking questions or problems, focusing on interdisciplinary linkages, authentic inquiry, collaboration and producing work and demonstrations.

The ability to solve students' mathematical problems is also important to improve. According to NCTM (2000) which states that problem solving is an integral part of mathematics learning so that it should not be separated from mathematics learning. Furthermore ruseffendi (2006) also argues that problem-solving skills are very important in mathematics not only for those who in the future will explore or study mathematics but also for those who will apply it in other fields of study and in everyday life. Based on some of the above opinions important problem-solving abilities are improved because students will be accustomed to solving problems in mathematics learning. Students with good problem solving will be able to solve mathematical problems more systematically.

Learning is a process of change in individual behavior obtained through experience, the process of stimulus response, habituation, imitation, understanding, appreciation, and through individual activities in achieving something that is desired. As for the notion of learning according to some experts namely, Wittaker in Nidawati (2013: 3) said that, "Learning may be defined as the process by which behavior originates or is altered through training or experience". Where the notion of learning is a process in which behavior arises through practice or experience.

Cronbach in Nidawati (2013: 3), said that "Learning is shown by change in behavior as a result of experience". Understanding learning here is effective learning is through experience. In the learning process, a person interacts directly with the learning object by using all the senses. Meanwhile, according to Howard L. Kingsley in Nidawati (2013: 3), "Learning is the process by which behavior (in the broader sense) is originated or changed through practice or training", which means that learning is a process in which behavior (in broad terms) is brought about through practice and practice. Bern and Erickson (2001: 5) assert that problem based learning is a student learning strategy in solving problems by integrating various concepts and skills from various scientific disciplines. This strategy includes gathering and uniting information, presenting findings.

Problem based learning (PBL) as one of the learning models has the characteristic of always starting and focusing on the problem. In PBL students can work in small groups and must identify what they know and what they don't know and must learn to solve a problem. The main role of the teacher is to facilitate the group and learning process, not to provide answers directly.

According to Paulina in Fatimah (2012) "learning using the PBL model has two core stages, namely the analysis of problem solving collectively and independent learning" Paulina (2001). As PBL's definition was put forward by Ronnis (2000) that PBL is a curriculum development and instructional system that simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem-solvers confronted with an ill-structured problem that mirros real-world problems ".

According to Arends, various development of teaching Problem Based Learning (PBL) has given the teaching model that has the following characteristics: Submitting Questions or Problems, Focusing on Interdisciplinary Linkages, Continuous Investigation, Producing Products and Showing Off, Collaboration and Collaboration

According to Greenwald (2000) there are ten steps in PBL learning, namely: encounter an ill-defined problem, have students ask questions about what is interesting, puzzling or important to find out / IPF questions, persoblem finding, map problem finding and prioritizing a problem, investigate the problem, analize the results, reiterate learning, generate solutions and recommendations, communicate the result, conduct self assessment. Meanwhile, according to john dewey, an education expert in the United States states there are six steps in PBL learning, formulating problems, analyzing problems, formulating hypotheses, collecting data, testing hypotheses, formulating recommendations for solving problems. While according to Jhonson and Jhonson the PBL steps include: Defining the problem, diagnosing the problem, formulating strategic alternatives, determining and implementing strategic choices, conducting an evaluation. Problem Based Learning or problem based learning has several advantages compared to other learning models including the following: Problem solving is a pretty good technique to understand the contents of the lesson, Problem solving can challenge students' abilities and provide satisfaction to find new knowledge for students, Problem solving can improve student learning activities, problem solving can help students how to transfer their knowledge to understand problems in real life. Similar to other teaching models, the Problem Based Learning model also has some shortcomings in its application. Weaknesses include: When students have no interest or do not believe that the problem being studied is difficult to solve, then they will feel reluctant to try, requiring enough time to prepare. Mervis (Hoosain: 2001) defines a problem as "a question or condition that is difficult to deal with and has not been solved". Meanwhile, Lester (Hoosain: 2001) states "A problem is a situation in which an individual or group is called upon to perform a task for which there is no readily accessible algorithm which determines completely the method of solution". Whereas Buchanan (Hoosain: 2001)

defines mathematical problems as "non-routine" problems that require more than ready-to-hand procedures or algorithms in the solution process.

In Becoming a better problem solver 1 (Ohio Department of Education, 1980 in Hoosain, 2001) it is stated that a mathematical problem has four elements, namely: a situation involving an initial statement (initial state) and a statement of purpose (goal state), the situation must be involves mathematics, A must want a solution. There are several blockages between the statement given and the statement desired (the given and desired states). This definition has an affective component (the will to find a solution) that is not found in the previous definitions. Kilpatrick (Hoosain: 2001) defines a problem as a situation with goals that must be achieved but the direct route to the destination is blocked. In the same way Mayer (Hoosain: 2001) states that a problem occurs when someone is faced with a "given state" and that person wants to achieve a "goal state". The three definitions above refer to the initial statement (initial state) and the statement of purpose (goal state) in a problem situation (problem situation). According to Bandura (1997: 80-115) states that there are four main sources that affect one's self-efficacy, namely: The experience of one's success in facing a particular task at a previous time. If someone has experienced success in the past, the higher the self-efficacy, conversely, if someone has failed in the past, the lower the person's self-efficacy, the experience of others. Individuals who see other people succeed in doing the same activities and have comparable abilities can increase their self-efficacy, conversely if people who are seen to fail then the individual's self-efficacy decreases. Verbal persuasion, i.e. information about one's abilities that is conveyed verbally by influential people so as to increase confidence that the abilities possessed can help to achieve what is desired. Physiological conditions, namely physical condition (pain, fatigue, etc.) and emotional condition (mood, stress, etc.). This oppressive situation can affect his belief in his ability to face the task. If there are negative things, such as tired, unhealthy, anxious, or depressed, will reduce a person's level of self efficacy. Conversely, if someone is in prime condition, this will contribute positively to the development of self efficacy.

Three indicators of self efficacy, according to Bandura (1997: 42-43) dimensions of self efficacy that are used as a basis for measurement of individual self efficacy are: Magnitude, Strength, Generalit. Student's Self-efficacy in Mathematical Problem Solving is important for everyone to deal with a problem at hand. This is reinforced by the evidence that self-efficacy greatly influences life.

2. METHODS

This type of research is a research and development method. Research and Development (Research and Development) is a research method used to produce certain products and test the effectiveness of these products. In this case the product that will be produced is problem based learning to improve mathematical problem solving abilities and self efficacy. The research procedure to be carried out is a research development carried out with reference to the procedure of Borg & gall (1989) which goes through several modifications. The procedures of Borg & Gall are: Research and Information Collectin, Plannin, Develop Preliminary of Products, Preliminary Testing, Main Product Revision), Main Field Test, Operational Product Revision, Operational Field Testing, Final Product Revision, Dissemination and Implementation). In the research development that will be carried out only limit to the sixth stage (Main Field Test). This was done because of time constraints in the development of learning undertaken by researchers.

Non-Instruments Non-test instruments used were interview and questionnaire guidelines. Interview guidelines are used during preliminary studies to determine the initial conditions of students. The second non-test instrument was in the form of a questionnaire to be used at several stages of the study. Test Instrument This instrument is a mathematical problem-solving ability test. This test is given individually and aims to measure the ability to solve mathematical problems. Before tests of mathematical problem-solving abilities are used during field tests, the tests are first tested on other classes that have taken the material to find out the validity, reliability, difficulty level, and power of distinguishing questions. Test validity, reliability, level of difficulty, and distinguishing features of the problem are explained as follows.

Based on the background, the formulation of the problems in this study are how is the process and results of the development of problem based learning (PBL) learning to improve students' mathematical problem solving abilities and self-efficacy that are valid, practical and effective.

1. Qualitative Data Qualitative data were obtained from interview data at the preliminary stage, the results of a review of various relevant research journals, and the results of a mathematics class VIII mathematics textbook review in the 2013 curriculum. These data were used as a reference for compiling the syllabus, lesson plans, and learning LKPD. The results of questionnaire data obtained at the syllabus, RPP, and LKPD validation stages were analyzed descriptively qualitatively. At the syllabus, RPP and LKPD validation stage, data obtained in the form of expert suggestions and comments, which are used as a guide to improve the syllabus, RPP, and LKPD. Data analysis of the results of the teacher's response questionnaire and the level of readability and interest of students was also carried out in a descriptive qualitative manner.
2. Quantitative Data Quantitative data were obtained from self efficacy questionnaires and tests of mathematical critical thinking skills. Data collection in this study was conducted by giving self efficacy questionnaires and tests of mathematical critical thinking skills before learning (pretest) and after learning (posttest) in the experimental and control classes. Data obtained from the pretest and posttest were analyzed using inductive statistical tests. Before carrying out statistical test analysis the prerequisite tests need to be carried out, namely tests of normality and homogeneity. a. Normality test Mathematical Problem Solving Ability The normality test data were obtained from the pretest and posttest results of class VIII A as an experimental class and class VIII B as a control class.

Table 1. Results of The Normality Test of The Pretest and Posttest Data In The Experimental Class And The Control Class.

Data	Asymp. Sig (2-tailed)	Description
Pretest Experiment Class	0,200	Asymp. Sig. (2-tailed) > 0,05 = normal
Posttest Experiment Class	0,200	Asymp. Sig. (2-tailed) > 0,05 = normal
Pretest Control Class	0,070	Asymp. Sig. (2-tailed) > 0,05 = normal
Posttest Control Class	0,200	Asymp. Sig. (2-tailed) > 0,05 = normal

Based on the table above, the significance is more than 0.05, it can be concluded that the control class posttest data is normally distributed.

1. Self Efficacy following are the results of the normality test of the pretest and posttest data in the experimental class and the control class.

Table 2. Results of The Normality Test of The Pretest and Posttest Data in the Experimental Class and the Control Class.

Data	Asymp. Sig (2-tailed)	Description
Pretest Experiment Class	0,150	Asymp. Sig. (2-tailed) > 0,05 = normal
Posttest Experiment Class	0,200	Asymp. Sig. (2-tailed) > 0,05 = normal
Pretest Control Class	0,200	Asymp. Sig. (2-tailed) > 0,05 = normal
Posttest Control Class	0,082	Asymp. Sig. (2-tailed) > 0,05 = normal

The normality test results of the experimental class pretest data distribution are known that the data has a significance of more than 0.05, so it can be concluded that the data is normally distributed.

Homogeneity Test

The results of the homogeneity test calculation of the pretest and posttest data, to test the students' mathematical problem solving abilities and self efficacy. These two things are explained as follows:

1. Mathematical Problem Solving Ability

After the normality test is carried out, then a homogeneity test is performed. The following results of the homogeneity test of the pretest and posttest data variants in the experimental class and the control class were assisted by the SPSS program.

Table 3. Results of the homogeneity test of the pretest and posttest data variants in the experimental class and the control class

Data	Sig.	Description
Pretest	0, 618	Sig. > 0,05 = homogen
Posttest	0, 925	Sig. > 0,05 = homogen

Thus, the significance is more than 0.05, it can be concluded that the pretest data of the experimental class and the control class have homogeneous variances.

2. Self Efficacy After the normality test is carried out, then a homogeneity test is performed. The following results of the homogeneity test of the pretest and posttest data variants in the experimental class and the control class were assisted by the SPSS program.

Table 4. Results of the homogeneity test of the pretest and posttest data variants in the experimental class and the control class

Data	Sig.	Description
Pretest	0,052	Sig. > 0,05 = homogen
Posttest	0,957	Sig. > 0,05 = homogen

Thus, the significance is more than 0.05, it can be concluded that the pretest data of the experimental class and the control class have homogeneous variances. After the data meets the normality test and homogeneity test, the analysis used is the t test (t test) with the help of SPSS.

3. RESULTS AND DISCUSSION

3.1 Product Development Results

The development is based on the steps of the development of Borg and Gall, the first step is a preliminary study, the next step is the development of learning problem based learning stages of learning development are arranged based on the objectives to be achieved by research, development of learning based on learning program developed to improve mathematical problem solving skills and student self efficacy. The resulting learning development was validated by several experts before field trials. Validation is given among them to model experts, media experts, psychologists. Validation is done to see the effectiveness of learning development by experts before being tried out later.

T-Pretest

Table 5. Results of the T-Pretest

Data	t_{count}	Df	Sig. (2- tailed)	Description
Pretest	-1,525	56	0,133	Sig. (2- tailed) > 0,05

Based on Table it can be seen the value of Sig. (2-tailed) = 0.133 > 0.05. Then it can be concluded, H0 is accepted. This means that there is no significant difference in the average pretest score between the mathematical problem solving abilities of students who take learning problem based learning and the mathematical problem solving abilities of students who take conventional learning. It can be concluded that the initial abilities of the two classes do not differ much or are equivalent.

Test t Posttest Score

Table 6. Results of the T-Posttest Score

Data	t_{count}	Df	Sig. (2- tailed)	Description
Posttest	-2.85	56	0,006	Sig. (2- tailed) < 0,05

Based on Table we can find out the value of Sig. (2-tailed) = 0.006 < 0.05. Then it can be concluded, H0 was rejected and H1 was accepted. This means that there is a significant difference in the average posttest score between the mathematical problem solving abilities of students who take learning problem based learning and the mathematical problem solving abilities of students who take conventional learning.

T-N-Gain Test

The pretest and posttest score scores of the two classes were analyzed using the t test, to find out whether there were significant differences in the average pretest and posttest scores of students' mathematical problem solving abilities who took part in learning problem based learning and mathematical problem solving abilities of students who took conventional learning. The conclusion of the study is stated at the 5% significance level. A summary of the t-test pretest and posttest scores is shown in Table, while the full calculation is presented in appendix.

Table 7. Results N-Gain

Data	T_{count}	Df	Sig. (2-tailed)	Description
N-GAIN	-2.199	56	0,032	Sig. (2- tailed) < 0,05

Based on Table it can be seen that the t test analysis of the pretest and posttest scores in the control class, obtained Sig. (2-tailed) = 0.032 <0.05. Then it can be concluded, H0 was rejected and H1 was accepted. This means that there are significant differences in the average pretest and posttest scores of students' mathematical problem solving abilities who attend problem based learning.

Self Efficacy

Student self efficacy data were obtained through pretest and posttest data which were implemented at the beginning and end of learning. Hypothesis testing is done using the t test with the help of SPSS for windows version 17.00.

Test of T-Pretest Score

Table 8. Results Of The T-Test Pretest

Data	t_{count}	Df	Sig. (2- tailed)	Description
Pretest	1,572	56	0,121	Sig. (2- tailed) > 0,05

Based on Table can be seen the value of Sig. (2-tailed) = 0.345 > 0.05. Then it can be concluded, H0 is accepted. This means that there is no significant difference in the average pretest score between self-efficacy of students who take learning Problem-based learning and self-efficacy of students who take conventional learning. It can be concluded that the initial abilities of the two classes do not differ much or are equivalent.

Test t Posttest Score

Table 9. Results of t Posttest Score

Data	t_{count}	Df	Sig. (2- tailed)	Description
Posttest	-2.208	56	0,031	Sig. (2- tailed) < 0,05

Based on Table it can be seen the value of Sig. (2-tailed) = 0.031 < 0.05. Then it can be concluded, H0 was rejected and H1 was accepted. This means that there is a significant difference in the average posttest score between students' self-efficacy who participate in learning Problem-based learning and self-efficacy of students who take conventional learning.

Test T Score

Table 9. N-Gain T Test

Data	tcount	Df	Sig. (2- tailed)	Description
N-GAIN	-3,123	56	0,003	Sig. (2- tailed) < 0,05

Based on Table it can be seen that the t test analysis of the pretest and posttest scores in the experimental class, obtained Sig. (2-tailed) = 0.003 <0.05. Then it can be concluded, H0 was rejected and H1 was accepted. This means that there are significant differences in the average pretest and posttest self efficacy scores of students who take learning Problem based learning.

4. CONCLUSION

Development of learning problem based learning to improve mathematical problem solving abilities and self efficacy based on the stages of development, beginning with field study to know the problems in the field and then followed up to develop a learning based on the problem in the field, then literacy studies are conducted to develop the learning process. The next stage is the oxidation by some experts who are then followed up by field trials. The ability to solve mathematical problems with problem based learning is more effective than the ability to solve mathematical problems with conventional learning. Self efficacy of students with problem based learning is more effective than self efficacy of students with conventional learning.

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