The Effect of Problem Based Learning Model on Students' Mathematical Problem Solving Ability on Social Arithmetic Materials at SMP Negeri 2 Limboto

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ABSTRACT
This research aims to determine the effect of using the Problem Based Learning Model on students' mathematical problem-solving abilities, which is higher than using a direct learning model on Social Arithmetic topic. This research was conducted at SMP Negeri 2 Limboto with the experimental method involving 2 classes as the experimental class and the control class with the number of students in each class, namely 20 students as the research sample selected using cluster random sampling technique. The research design used was a pretest-posttest control group design and the data collection technique used was giving a problem-solving ability test in the form of an essay. Inferential analysis in this study using the ANCOVA test. The results of this study indicate that the mathematical problem solving abilities of students who are taught using the Problem Based Learning Model is higher than the mathematical problem solving abilities of students who are taught using the Direct Learning Model on Social Arithmetic material.
Keywords: Problem Based Learning Model, Problem Solving Ability, Social Arithmetic

Introduction

Mathematics is one of the subjects taught in schools with the highest percentage of lesson hours compared to other subjects. Ironically, mathematics is a subject that many students dislike. For them, mathematics tends to be seen as a subject that is "less desirable" and "if it can be avoided". The fear of students is not only caused by the students themselves, but the teacher's lack of ability to create situations that can bring students interested in mathematics. A good mathematics teaching and learning process is that the teacher must be able to apply an atmosphere that can make students enthusiastic about the existing problems, so that they are able to try to solve the problem. Learning mathematics will be more meaningful if children "experience" with what they learn,[1]. With the creativity of teachers in managing the class, students will feel comfortable in participating in mathematics learning activities. Therefore, students' interest in learning mathematics will increase.

Based on the results of an interview with one of the mathematics teachers, Mrs. Kasma Lahabu, S.Pd. Accompanied by the results of observations carried out by

researchers on December 7, 2020 that students have not been able to analyze problems in the form of problems, do not understand how to convert problems into mathematical models which causes students' problem solving abilities are still relatively low. It can be seen that in offline and online learning students still tend to be passive and the teacher provides information directly, where students only accept and apply the formula without knowing the origin and why of using the formula. In the Social Arithmetic material, students' difficulties begin with the students' lack of mastery of the prerequisite material, namely algebraic operations material. Where students are less able to operate integers. Besides that,

To overcome this problem, a more varied learning model is needed. One alternative that can be a teacher's choice in the learning process is the effectiveness of the use of learning models. One of the learning models that can improve students' mathematical problem solving abilities is learning with the Problem Based Learning (PBL) model. Boud and Felleti (in Andi 2018: 53) state that the teaching and learning process with the Problem Based Learning (PBL) model is a learning model that challenges students to find solutions to real-world problems individually or in groups.[2]. The Problem Based Learning (PBL) learning model is designed in the form of learning that begins with the structure of real problems related to the mathematical concepts to be taught, students not only receive information from the teacher, but the teacher must motivate students and guide students to play an active role. in the whole learning process.

Various studies related to the Problem Based Learning model have so far been studied in many ways, such as: 1) Influence on students' mathematical logical thinking skills[3], 2) Students' ability to understand mathematical concepts[4], 3) Improving student learning outcomes[5], 4) Improving critical thinking skills[6]. 5) Comparison with scientific learning on student learning outcomes[7], 6) Application in improving students' quantitative reasoning[8]. In addition, research that examines Problem Solving Ability has also been carried out previously in various ways such as: 1) The relationship with students' mathematical communication skills[9], 2) Trigonometry module development[10], 3) Effect of Construct-based Educational Game learning media[11], 4) Relationship with understanding of mathematical concepts on computer self-efficacy[12], 5) Application of Indonesian Realistic

Mathematics Approach (PMRI)[13]. The research related to Social Arithmetic material has been widely studied, such as in terms of: 1) Analysis of student errors in solving problems[14], 2) Development of interactive learning media based on Camtasia and Wondershare Quiz Creator[15], 3) Describing students' mathematical reasoning abilities[16], 4) Development of a mathematical module based on a scientific approach[17], 5) Students' mathematical logical thinking ability, development of Student Activity Sheets[18]. From the many studies that have been mentioned previously, it shows that this research topic is still open for research.

Therefore, in this article the researcher conducted an experiment, namely the use of the Problem Based Learning model on students' mathematical problem solving abilities. Researchers feel the need to do this research because problem solving ability is one of the important goals that must be achieved in the process of learning mathematics. The results of this research are expected to use the Problem Based Learning model to have a good influence on the mathematical problem solving ability of students in social arithmetic material.

Research methods

This research was conducted at SMP Negeri 2 Limboto. This research was conducted in the Even Semester of the 2020/2021 Academic Year. This research is an experimental research, using two classes as research objects, 1 class is used as an experimental class using the Problem Based Learning model and 1 class is used as a control class using the Direct Learning model.

The design used in this study is the Pretest-posttest Group Design[19].In this design, two groups were selected randomly. The first group was given treatment (X) and the other group was not. The group that was given treatment was called the experimental group and the group that was not treated was called the control group. Then given a final test (post-test) to find out the final state of mathematical problem solving abilities

students between the experimental group and the control group. The research design is presented in Table 1.

Table 1. Research Design

Class	Pretest	Treatment	Post Test
Experiment	O1	X1	O2
Control	O1	X2	O2

Source: Sugiyono Book, 2017

Information :
X1 : Learning using Problem Based Learning (PBL)
X2 : Learning using Direct Learning
O1 : Pretest for experimental class and control class
O2 : The final test (post test) for the experimental class and the control class

The independent variable in this research is the student response in learning using the Problem Based Learning model and the Direct Learning model in learning Social Arithmetic material. The dependent variable in this study is the ability to solve mathematical problems and the accompanying variable in this study is the initial ability of students which is indicated by the initial score. before learning (pre-test). The population in this study were all seventh grade students of SMP Negeri 2 Limboto which consisted of 6 classes with a total of 142 students. In this research, sampling was done by cluster random sampling, where the class that became the experimental class was class VII-2 and the control class was class VII-3.

The data collection technique in this study was in the form of a test instrument in the form of an essay consisting of an initial test (pre-test) and a final test (post-test) which contained indicators of solving mathematical problems. This test is used to determine students' mathematical problem solving abilities on social arithmetic material. Before the test is given to students, it is necessary to test its validity and reliability. The data analysis technique used in this research is descriptive analysis test and anacova inferential analysis test.

Results and Discussion

Descriptive Analysis Test Results

In general, the description of the data on students' mathematical problem solving abilities from the two classes given the treatment can be seen in Table 2.

Table 2. Description of Pre-Test and Post-Test Data

Data	Class	N	Min Score	Max Score	mean ($\underline{x}$)	Median (Me)	Mode (Mo)	Standard Deviation (SD)	variance (S^2)
Pre-test	E	20	7	20	12.05	11.51	11	3.26	10.68
	K		6	19	11.05	10.63	9	3.40	11.62
Post-test	E	20	14	28	21.9	21.75	21.37	3.24	10.51
	K		11	25	17.4	17.49	18	3.45	11.93

Covariance Analysis Test Results

1) Determine the regression model.

The experimental class regression model is obtained:

$$\hat{Y} = 14{,}062 + 0{,}655X$$

The control class regression model is obtained:

$$\hat{Y} = 8{,}2066 + 0{,}8624X$$

2) Test of X's Independence towards Y/ Test of significance of X's coefficient in the regression model.

- Experiment Class

In summary, the results of the calculation of the analysis of variance for the experimental class are presented in Table 3.

Table 3. Analysis of the Variance of the Experimental Class Regression Coefficient of Independence Test

Source Of Variation	SS	df	MS	F*
Regression	88.556851	1	88.556851	12.12709
Error	131.4431	18	7.3023971	
Total	219.999951	19		

The results of the calculations as listed in Table 3. show that the price F* = 12.12709. While in the distribution table F, obtained . This means that F* > Ftable, so H0 is rejected. That is, there is a significant effect between students' initial abilities on students' mathematical problem solving abilities after receiving treatment in the experimental class.$F_{(0,05;1;18)} = 4{,}41387$

- Control Class

In summary, the results of the calculation of the analysis of variance for the control class are presented in Table 4.

Table 4. Analysis of Variance of Independence Test of Regression Coefficient of Control Class

Source Of Variation	SS	df	MS	F*
Regression	158,3814	1	158,3814	33.0847
Error	86,16858	18	4.7871	
Total	244.54998	19		

The results of the calculations as listed in Table 4. show that the price of F* = 33.0847. While in the distribution table F, obtained . This means that F* > Ftable, so H0 is rejected. That is, there is a significant effect between students' initial abilities

on students' mathematical problem solving abilities after receiving treatment in the control class.$F_{(0,05;1;18)} = 4,41387$

3) Test the linearity of the regression model

- Experiment Class

The results of the calculation of the linearity test of the experimental class regression model are listed in the appendix with a brief presentation of the data in Table 5.

Table 5. Analysis of Variance of Linearity Test of Experimental Class Regression Model

Source Of Variation	SS	df	MS	F*
Error	131.4431	18		-0.991597
Lack Of Fit	-15511.2	9	-1723.47	
Pure Error	15642.7	9	1738.07	

From the presentation of Table 5. the value of F* = -0.991597, and based on table F for the significance level . By comparing the two values of F, it is obtained that F* < Ftable, then H0 is accepted. This means that in the experimental class, the results of the pre-test (students' mathematical problem solving abilities before learning) have a linear relationship with the post-test results (students' mathematical problem solving abilities after learning using the Problem Based Learning model).$\alpha = 0,05 F_{(0,95;9;9)} = 3,178893$

- Control Class

The results of the linearity test of the control class regression model are listed in the appendix with a brief presentation of the data in Table 6.

Table 6. Analysis of Variance for Linearity Test of Control Class Regression Model

Source Of Variation	SS	df	MS	F*
Error	86,16858	18		-0.77646
Lack Of Fit	-2842.5	10	-284.2455	
Pure Error	2928.6	8	366.0780	

From the presentation of table 6. obtained the value of F* = -0.77646, and based on table F for the significance level . By comparing the two values of F, it is obtained that F* < Ftable, then H0 is accepted. This means that in the control class, the results of the pre-test (students' mathematical problem solving abilities before learning) have a linear relationship with the post-test results (students' mathematical problem solving abilities after learning using the Direct Learning model).$\alpha = 0{,}05 F_{(0{,}95;10;8)} = 3{,}34716$

4) Similarity test of two regression models

Based on the calculation results obtained the value of F* = 10.05104. The value of Ftable at the significant level was obtained . By comparing the values of F* and Ftable, it is found that F* > Ftable, which means that H0 is rejected. This shows that the two regression models are not the same. Or in other words, the experimental class regression model and the control class regression model were significantly different. If it is proven that the regression model is significantly different, then it is continued with the parallelism/homogeneity test.$\alpha = 5\% F_{(0{,}95;2;36)} = 3{,}25945$

5) Alignment test of two regression models

Table 7. Analysis of Variance for Regression Model Homogeneity Test

Group	Sum of Squares		Sum of Product	Adjusted Sum of Squares for x
	X	Y	XY	
Experiment	205,80	220	135	131.4431
Control	212.95	244.55	183.65	86.1685
Total	418.75	464.55	318.65	217,6117

Based on the complete calculation results in the attachment, it is obtained that F* = 0.73780 and at the level of or . Because then H0 is accepted. This means that the experimental class regression model and the control class regression model are parallel. So it can be concluded that there are differences in students' mathematical problem solving abilities in the experimental class and the control class. For this reason, the data were then analyzed using the ANACOVA method.$\alpha = 5\% F_{(0{,}95;1;36)} = 4{,}1131 F^* = 0{,}73780 < F_{\text{tabel}} = 4{,}1131$

Based on the calculation of the Covariance Analysis attached in the appendix, it is obtained . After being compared with the obtained value, then H0 is rejected. This means that the problem solving ability of students who are taught using the Problem Based Learning model is higher than the problem solving abilities of students who are taught using the Direct Learning model.$F^* = 19{,}503 F_{\text{tabel}} = F_{(0{,}95;1;37)} = 4{,}105 F^* = 19{,}503 > F_{\text{tabel}} = 4{,}105$

Based on the results of the inferential analysis of the simple regression model for the experimental class which states the relationship between pre-test (initial ability) and post-test (mathematical problem solving ability) which is learned using

the Problem Based Learning model and a simple regression model for the control class which states the pre-test relationship. (initial ability) and post-test (mathematical problem solving ability) which are taught using the Direct Learning model are . From the analysis of the regression model, it is clear that there is a difference between the class that was taught using the Problem Based Learning (experimental) model and the class that was taught using the Direct Learning (Control) model where the constant of the experimental class regression model is greater than the constant of the control class regression model. When viewed from the graph of the regression model,$\hat{Y} = 14{,}062 + 0{,}655X\hat{Y} = 8{,}2066 + 0{,}8624X$

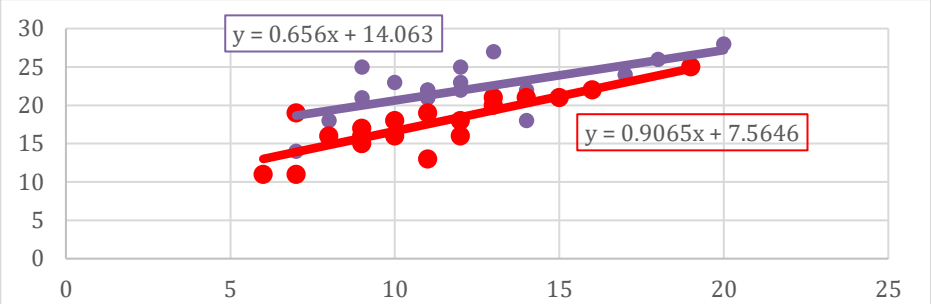

Figure 1. Parallel Graph of Two Regression Models

As can be seen in Figure 1., it can be concluded that the mathematical problem solving ability of class VII students of SMP Negeri 2 Limboto who uses the Problem Based Learning model is higher than the mathematical problem solving ability of students who are taught using the Direct Learning model. This is due to the different treatment given between the two classes, where the experimental class is taught using the Problem Based Learning model and the control class is taught using the Direct Learning model.

Based on the observations of the researchers during the learning process using the Problem Based Learning model, starting from giving students mathematical problems with social arithmetic material which were packaged in several videos and displayed through projectors, where students were given time to observe the problem and at the end of the video there would be questions about the problem. This can improve students' critical thinking skills in solving problems and gaining knowledge of important concepts. The students seemed very enthusiastic in answering these questions. Students really enjoy learning using this model and social arithmetic material can be completed without taking up much time. This factor affects the success of learning by using the Problem Based Learning (PBL) model. It is different with the control class which is taught using the Direct Learning model. During the teaching and learning process students seem less concerned about the material being taught. Students are only busy taking notes and following the explanations presented through powerpoint media. Therefore, the researcher saw that this class was not conducive during the teaching and learning process.

Based on the discussion, the results of data processing, analysis and hypothesis testing that have been carried out, the description shows that there are differences in

students' mathematical problem solving abilities in social arithmetic material because of differences in treatment in the experimental class and control class. So that the hypothesis made earlier can be proven, thatThe problem-solving ability of students who are taught using the Problem Based Learning model is higher than the problem-solving ability of students who are taught using the Direct Learning model of Social Arithmetic material in Class VII SMP Negeri 2 Limboto. This shows that the use of the Problem Based Learning model has a good influence on students' mathematical problem solving abilities.

Conclusion

The use of the Problem Based Learning model has an effect, where students are enthusiastic in learning, are more active in solving problems and students' mathematical problem solving abilities are higher than those using direct learning models. So it can be concluded that the effect of using the Problem Based Learning model is better on students' mathematical problem solving abilities on social arithmetic material for class VII SMP Negeri 2 Limboto.

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