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The Effect of Manipulative PBL Model on The Understanding Mathematic Concepts for Elementary Students

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Abstract: The purpose of this study 1) analyze how much influence the Problem Based Learning model has on the understanding of elementary school students' mathematical concepts; 2) analyze how much influence the manipulative teaching aids-based learning model has on the understanding of elementary school students' mathematical concepts and 3) analyze how much difference the influence of the Problem Based Learning model and the Problem Based Learning model based on manipulative teaching aids to the understanding of elementary school mathematical concepts. This research is an experimental quasi study with a form of nonequivalent control group design. Samples of the study are from 3 elementary schools namely from class VI Public Elementary School number 2 Kalitengah, Public Elementary School number 1 Kangkung and Public Elementary School number 3 Kangkung. Purpose sampling technique was employed in this study. Data collection method includes observation, questionnaire and written test. Data analysis includes description of data, analysis prerequisite test, and hypothesis testing using t-test. Findings revealed there is a significant influence of the problem-based learning model on the understanding of mathematical concepts and confidence of elementary school students. There is a significant influence of the problem-based learning model based on manipulativeteaching aids on the understanding of mathematical concepts and the confidence of elementary school students and a significant difference in the influence of the model based on problem-based learning and problem-based learning based on manipulative teaching aids on understanding mathematical concepts and the confidence of elementary school students.

Keywords: PBL, teaching aids, concepts, confidence

1. Introduction

Mathematics learning refers to the teaching and learning process that is designed and built by teachers to develop students 'creative thinking skills that can improve students' thinking abilities and can improve the ability to construct new knowledge as an effort to increase good mastery of mathematics material (Ahmad Susanto, 2016). Mathematics is known as a subject that is difficult for students to understand. Even most of the students feel afraid of this lesson. Even though this lesson is given at all levels of education, from basic education, junior secondary education, senior secondary education and even higher education (Oluwaleyimu et al., 2020). To help solve problems that occur every day in mathematics learning, mathematics teachers must be able to simplify abstract mathematical objects so that they are easily learned and accepted by students (Harun et al., 2021). One learning approach that is able to simplify abstract problems into concrete ones in everyday life is to apply exercises in the form of assignments every morning for mathematics using the Problem Based Learning model approach.

Learning activities based on the Problem Based Learning model are focused on the core concepts and principles of a discipline, provide facilities for investigations, problem solving, and other meaningful tasks, are student centered, and produce real products (Santyasa, 2006). In terms of the application of Problem Based Learning, there are several steps that must be applied. The first step in Problem Based Learning is determining the basic questions and the final result is the creation of a problem solving from students.

Muhammad & Muhammad (2017) expressed that problem-based learning (PBL) is based on constructivism theory, where students are trained to develop critical thinking, problem solving, and collaborative skills as they identify problems, formulate hypothetical solutions, search for data, conduct experiments, formulate solutions and determine the

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best solution to solve the problem. Rahman (2018) mentioned PBL as the use of various kinds of intelligence that are needed to confront real-world challenges, the ability to deal with everything, new and existing complexities. Nafiah & Suyanto (2014) shared that PBL emphasizes learning as a process that involves problem solving and critical thinking in an actual context. Saleh (2013) states that PBL is a learning method for students to solve problems and reflect on them with learning experiences, thus enabling the development of thinking skills (reasoning, communication, and connection) in solving problems that are meaningful, relevant and contextual.

Hosnan (2014) states that the main principle of Problem Based Learning is the use of real problems as a means for students to develop knowledge and skills for critical thinking, creativity and problem-solving abilities in everyday life as well as direct benefits when resolved. The problem raised should be an open-ended problem, a problem that has many answers or solution strategies that stimulate students' curiosity to identify these strategies and solutions (Muhammad Baba Gasau & Mohamad, 2020).

According to Rumampunk in (Ansar, 2021) there are many types of objects that can be manipulated to study mathematics, known as manipulative teaching aids. The manipulative teaching aids referred to are all objects that are modified or treated, design such as real (concrete) objects and close to the daily life of students. Mariani, Suardika, & Manuaba (2014) state that the application of concrete media can concrete abstract material, and it is hoped that it can attract students' interest in learning so that learning becomes fun.

Suydan and Higgins (2018) suggest that manipulative materials (teaching aids) should often be used in total mathematics learning in accordance with the learning objectives. Manipulative materials should be used in conjunction with other assistive devices, including pictures, diagrams, textbooks, films and similar materials. In line with Bruner (Susilowati, 2014) said in learning activities, children should be given the opportunity to manipulate objects, so that children can directly see the order and patterns in the objects they are paying attention to. The use of media in learning is very useful when presenting material that cannot be presented directly by the teacher during learning.

Learning mathematics with a serious and meaningful understanding will bring students to feel the benefits of mathematics in everyday life (Agustina, 2016: 2). Understanding the concept is a type of learning outcome that is higher than knowledge. For example, it can explain in the correct order according to what it read or heard, provide other examples of examples that have been exemplified, or use application instructions in other cases. Mathematics is meaningless if you just memorize it. In reality, many students are only able to memorize concepts without being able to use them in problem solving (Mohmed, 2021). The application of the PBL model is also used manipulative teaching aids that will make it easier for students to understand the concepts of mathematics material. The application of PBL makes students more active in learning (Dita et al., 2021). Students can explore all potential. The problems raised in PBL are problems related to everyday life, plus the use of teaching aids will make it easier for students to construct theories in reality.

Based on existing problems and research, a study was conducted to determine the effect of using PBL based on manipulative teaching aids on understanding the mathematical concepts of elementary school children.

2. Research Methods

This research is an experimental quasi study with a form of nonequivalent control group design Samples of the study are from 3 elementary schools namely from class VI Public Elementary School number 2 Kalitengah, Public Elementary School number 1 Kangkung and Public Elementary School number 3 Kangkung. Purposive sampling technique was employed in this study. Data collection method includes observation, questionnaire and written test. Data collection includes description of data, analysis prerequisite test, and hypothesis testing using t test.

2.1 Data Source

The design of this study used a quasi-experiment design. The research design consisted of two groups, each of which was randomly selected (R). The first group was given treatment (X) and the other group was not, in the study, the group that was given treatment was called the control group.

The experimental research consisted of two classes, then from the two groups randomly selected one class to be the experimental group and the control class. Before being given the treatment, each group (V1, V2) was analyzed for the same using the daily test scores and the math breakfast in semester 1, this analysis was included to determine the homogeneity and normality of the sample, then the experimental group was treated using the Problem Based Learning model, while the control group was treated using a varied lecture model, then the two groups were given test questions to determine learning outcomes using data analysis techniques in the form of t-test or the difference between the experimental group and the control group.

2.2 Data Collection Technique

This study employed several data collection techniques to obtain data. The techniques used are as follows:

3.3.1 Test

Arikunto (2006) states that tests are a series of questions or exercises and other tools used to measure skills, intelligence knowledge, abilities or talents possessed by individuals or groups. This test is conducted at the end of learning activities to measure students' critical thinking skills.

3.3.2 Observation

According to Sukardi (2021) states that "Observation is another instrument that is often found in research used". The observation used in this research is open observation where the researcher in carrying out his duties in the midst of the respondent's activities is known openly. So that between researchers and respondents there is nothing to hide. This observation is used to obtain the necessary data and with this observation data will be obtained about the attitude of self-confidence of students during learning activities.

3.3.3 Questionnaire or Questionnaire

The questionnaire or questionnaire as a data collection tool generally consists of a series of statements or written statements that are used to collect the desired research information. The questionnaire used in this study was a student questionnaire. Researchers used a questionnaire technique to obtain data on PBL and PBL learning models with manipulative teaching aids in mathematics lessons.

2.3 Test Analysis Technique

To get good research validity when doing this research, it is necessary to describe the research procedures to be carried out, namely: 1) Determining the research sample using purposive sampling technique; 2) Taking the initial data (pretest) of students in the experimental class and the control class for normality and homogeneity tests. The goal is that the control class and the experimental class have the same homogeneity and normality levels before they are carried out; 3) Develop expository learning activities; 4) Carry out expository learning activities in the control class; 5) Arrange learning activities Problem Based Learning; 6) Implement Problem Based Learning activities in the experimental class; 7) Analyze the results of the experimental class and control class. 8) Compiling research results.

3. Results and Discussion

The results of descriptive analysis of student learning outcomes can be seen in Table 1.

Table 1: Descriptive Analysis of Question Instruments

		PBL Class Pretest	Pretest PBL class based on manipulative teaching aids	Control Class Pretest	PBL class posttest	Posttest PBL class based on manipulative teaching aids	Posttest Control Class
N	Valid	23	21	24	23	21	24
	Missing	45	47	44	45	47	44
Mean		39.57	39.76	41.98	71.63	82.26	50
Std. Error of Mean		1.05	1.076	0.927	1.107	1.278	1.032
Median		40	40	42.5	70	85	48.75
Mode		38[a]	42	45	68	85	48
Std. Deviation		5.037	4.931	4.543	5.309	5.858	5.054
Variance		25.371	24.315	20.641	28.187	34.315	25.543
Range		20	22	15	18	20	18
Minimum		30	30	35	62	70	42
Maximum		50	52	50	80	90	60
Sum		910	835	1008	1648	1728	1200

Table 1 shows that Pretest Value, At experiment class PBL model with a total sample of 23 students. Average value of 39.57 with a maximum value of 50 and a minimum of 30. The standard deviation is 5.037. The experimental class 2 with the PBL model based on manipulative teaching aids, the total sample was 21 students. with an average value of 39.76. The maximum value is 52 and the minimum value is 30 Standard deviation is 4,931. Control class with conventional learning. The number of samples is 24 students. The average value is 41.98, the maximum value is 50 and the minimum value is 35 and the standard deviation is 54,543. From the results of the pretest scores, it can be concluded that there is no significant difference from the students' initial abilities. Besides, the students' initial ability from the pretest scores is the same or the average is the same and that Posttest Value, experiment class 1 with PBL

model with a total sample of 23 students. The average value is 71.63 with a maximum value of 80 and a minimum of 62. The standard deviation is 5,309. The experimental class 2 with the PBL model based on manipulative teaching aids, the total sample was 21 students. with an average value of 82.26. The maximum value is 90 and the minimum value is 70 Standard deviation of 5.858. Control class with conventional learning. The number of samples is 24 students. the average value is 50, the maximum value is 60 and the minimum value is 42 and the standard deviation is 5.054.

From the results above, there is a difference between the students' average scores in the experimental class and the control class. This difference can be seen from the post test scores after receiving the learning model treatment. The results of the descriptive analysis of the data obtained from the test instrument in the form of pre-test questions concluded that the thinking ability of students in each class was almost the same and there was nothing that stood out. In the post test data analysis, there was a difference in the average score of the PBL class and the control class, this proves that there is an effect. after the class was treated with the PBL model which proved an increase in post-test scores.

Based on the t test on learning outcomes in the form of tests, the t value is 14.31, while the t table with df = 45 is 2.0167, then the t value> t table (14.31,> 2.0167). This means that there is a significant effect on the application of the problem-based learning (PBL) model on understanding mathematical concepts. compared to conventional learning models. Apart from the test instrument, this study used a questionnaire instrument to examine students' self-confidence. From the results of the descriptive analysis of the frequency distribution of the respondents 'answers to the questionnaire on students' self-confidence, the most answers were in the medium category of 8 students or 35%. and the average value of 67.17 is included in the medium category. This proves that the implementation of PBL affects students' self-confidence.

Based on the t test of the PBL class based on manipulative teaching aids and the control class of the test instrument, the t count was 19.84, while the t table with df = 43 was 2.0195, then the t value> t table (14.31,> 2, 0195). This means that there is a significant effect on the application of the problem-based learning model (PBL) based on manipulative teaching aids on understanding mathematical concepts. compared to conventional learning models. The t test results for the questionnaire instrument were used to compare whether there was an effect on the implementation of PBL based on manipulative teaching aids on students' self-confidence. The mean or mean value for the PBL class with manipulative display is 83.86 and for the control class is 39.75, the t value is -8.223, while the t table with df = 42 is 2.0211 then the t value> t table (23,359,> 2,0211).

These results indicate that there is a significant mean difference between PBL based on manipulative teaching aids and the control class. and count> t table. This proves that there is a significant influence on the PBL learning model based on manipulative teaching aids on the self-confidence of elementary school students. The conclusion is that PBL based on manipulative teaching aids is more effectively used to increase the self-confidence of elementary school students compared to conventional learning.

The effectiveness of teaching PBL and PBL models based on manipulative teaching aids has been proven to increase students' conceptual understanding and student self-confidence. This can be seen from the mean value of the students' post-test results or the mean for the PBL class of 71.63 and for the PBL class. based on manipulative props of 82.26. The mean results for the questionnaire instrument also differed for the PBL 67.17 model and the PBL model based on manipulative teaching aids of 83.86. The difference in means is not very significant. This means that the use of the PBL model based on manipulative teaching aids is more effective than the PBL model, but when compared to the conventional model the PBL model and PBL based on manipulative teaching aids are more effective for increasing the understanding of mathematical concepts and the confidence of elementary school students.

There are many problems with lack of confidence in students. students will be embarrassed to ask questions, answer questions and make presentations due to the lack of confidence in students not being able to understand the lesson which results in less student learning outcomes. There are several ways to overcome students' lack of self-confidence, namely 1) giving students the opportunity to interact with others; 2) getting students to appear speaking in public; 3) giving appreciation or praise for student work; 4) giving them confidence in students to carry out a task; 5) encourage students to participate in activities with their friends; 6) tell motivational and inspirational stories; 7) give attention when students need it; 8) treat children like adults.

4. Conclusion

Based on the results of the research that has been carried out under the title the effect of Problem Based Learning based on manipulative teaching aids on the understanding of mathematical concepts and the self-confidence of elementary school students, it can be concluded that:

- There is an effect of the Problem Based Learning model on understanding mathematical concepts. This is evidenced by t count> t table. The Sig (2-tailed) value is 00 <0.05. then Ho is rejected and Ha is accepted so that hypothesis 1 is proven.
- There is an effect of the Problem Based Learning model on the self-confidence of elementary school students. This is evidenced by the average value for the PBL class with manipulative display of 67.1739 and for the control class of 39,9583, the t value is 16.34, while the t table with df = 45 is 2.0167, the t value> t table (16.34, > 2.0167). then there is a significant influence on the application of the problem-based learning (PBL) model on

the self-confidence of elementary school students because the value of t count> t table, and the average student who has differences.

- There is an effect of the Problem Based Learning model based on manipulative teaching aids on understanding mathematical concepts. This is evidenced by t count> t table. while the significance value (2-tailed) is 00 <0.05. then Ho is rejected and Ha is accepted so that hypothesis 2 is proven.
- There is an influence of the Problem Based Learning model based on manipulative teaching aids on the self-confidence of elementary school students. With the most students answering the questionnaire, they were confident in a very high category. and the average value of 83.86 is included in the medium category. This proves that the implementation of PBL based on manipulative teaching aids affects students' self-confidence.
- There are differences in the effect of the Problem Based Learning and Problem Based Learning models based on manipulative teaching aids on understanding mathematical concepts. This is evidenced by t count> t table. Sig value. (2-tailed) of 00, the Sig. (2-tailed) 0.00 <0.05. then Ho is rejected and Ha is accepted so that hypothesis 5 is proven.
- There are differences in the effect of the Problem Based Learning and Problem Based Learning models based on manipulative teaching aids on the self-confidence of elementary school students. This is because problem-based learning is a learning approach that uses real-world problems as a context for students to learn about critical thinking and problem-solving skills, as well as to acquire essential knowledge and concepts from the subject matter.

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