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THE EFFECT OF PROBLEM-BASED LEARNING MODEL ON STUDENTS' MATHEMATICAL COMPUTATIONAL THINKING SKILLS

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ABSTRACT

This study aims to determine the effect of Problem Based Learning model on students' mathematical computational thinking ability. The sample of this study involved 8th grade students of Madrasah Tsanawiyah (MTs) Hifzhil Qur'an Yayasan Islamic Centre Sumatera Utara in the 2023-2024 school year totaling 53 people. The sampling technique used was *cluster random sampling* so that researchers had 2 class groups, namely class 8-3 as the experimental class and class 8-4 as the control class. The method used is quantitative experimentation with a research design in the form of *True Experimental Design* in the form of *Post-test-Only Control Design*. The analysis of this study used *Independent Sample t Test* and obtained a sig value. <0,001. Thus, H_0 is rejected and H_a is accepted, meaning that there is a significant effect of using *Problem Based Learning* model on students' mathematical computational thinking skills.

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1. INTRODUCTION

The professional organization of science teachers in the United States and Canada, National Science Teaching Association (NSTA) says that 21st century skills in education are developed in the form of thinking skills and problem-solving skills. One of the skills that can support thinking and problem solving is computational thinking (Manullang & Simanjuntak, 2023).

According to Grover & Pea (2013) computational thinking is the process of thinking in solving problems to get a solution by using basic computer concepts. Computational thinking is defined as a way of understanding and solving complex problems using

computer science techniques and concepts such as decomposition, abstraction, pattern recognition, and algorithms (Marifah, 2022).

Computational thinking skills are needed in education because they can help students develop creative, critical and analytical thinking skills when solving complex problems both in the context of computing and in everyday life (Manullang & Simanjuntak, 2023).

Through computational thinking skills, students can also develop their ability to find weaknesses or errors in solutions and correct them quickly (Christi & Rajiman, 2023). In addition, this computational thinking ability will help students to improve their ability to solve problems (Maharani, 2020).

The results of research on the level of computational thinking skills of students in Indonesia show that they are at a low level ((Angeli & Giannakos, 2020); (Satrio, 2020); (Manullang & Simanjuntak, 2023); (Dewi et all., 2024); (Pratiwi & Akbar, 2022)). This is because learning activities in the classroom do not support students to develop computational thinking skills. Learning carried out in the classroom is conventional which only emphasizes memorization and uses only a few formulas to solve mathematical problems. Such learning results in students' computational thinking skills being under-trained (Damayanti, 2023).

Research results Zufarisna (2023) shows that learning in the classroom must involve students in a problem so that students' computational thinking skills are trained and improved. Thus, an appropriate learning model is needed to activate as well as improve this computational thinking ability. One of the learning models that can improve computational thinking skills is *Problem Based Learning* model.

Setiani et all. (2020) stated that *Problem Based Learning* model is a student-centered learning model by confronting students with a number of problems that can improve students' conceptual abilities, thus affecting the ability to solve students' mathematical problems.

Problem solving is one of the points needed to improve computational thinking skills. According to Surahman & Ulfa (2020) *Problem-based learning* is a computational-based learning model that can improve computational thinking skills. Therefore, the Problem Based Learning model can improve students' mathematical computational thinking skills because this model involves students with everyday problems that must then be solved by students independently or in groups, so that students' computational thinking skills are trained.

2. METHOD

The method in this research is quantitative method with experimental research type. This study uses a design in the form of *True Experimental Design* in the form of *Post-test-Only Control Design*. The sample in this study involved 53 8th grade MTs students with a population of all 8th grade students of MTs Hifzhil Qur'an Islamic Center Foundation of North Sumatra in the 2023-2024 school year totaling 123 people.

Based on the results of interviews with mathematics teachers at the school, each class has the same ability. So, for sampling is done using *cluster random sampling* technique so that two classes are obtained, experimental class and control class. In this study, the experimental class was class 8-3 and the control class was class 8-4.

The procedure for conducting this research is as follows:

(1) Research Preparation: the preparation begins with submitting a research permit, then consulting with the school and the mathematics teacher in class VIII. Arranging or designing research instruments is also done at this stage. Before this research was carried out, first the validity and reliability tests were carried out to find out that the instrument

Table 1. Research Design

Experiment	X	O_1
Control		O_2

Information:
X : Treatment with problem based learning model
O_1 : Post-test of mathematical computational thinking in experiment class
O_2 : Post-test of mathematical computational thinking in control class

was valid and reliable to be tested on students. The validity test of the test instrument in this study was carried out using the SPSS Statistics 29 program. The basis for conducting a validity test is to pay attention to the value of the 5% significance level in the distribution of statistical values. If the significant value <0.05 then it is declared valid. If the significant value> 0.05 then it is declared invalid. In the validity test calculation, all items tested obtained a sig value. <0.001, this indicates that the items are valid. Furthermore, the calculation of the reliability test using the SPSS Statistics 29 program obtained a value of 0.774. An instrument is said to be reliable if the Cronbach Alpha value is> 0.6. The value that the researcher obtained has met the requirements> 0.6. Thus the test instrument is declared reliable. Based on the analysis of the test results, it can be concluded that each test question can be used to measure students' computational thinking skills. After testing and getting valid and reliable results, the instrument is suitable for use and researchers can carry out research by giving treatment to experimental and control classes. The question instrument in the form of a final test (post-test) contains 3 items in the form of descriptions that have contained indicators of computational thinking skills, namely decomposition, pattern recognition, algorithms, and abstraction/generalization. With a score of 4: if *solving the problem correctly*; score 2: if *solving the problem but wrong*; and score 0: if *not answered* on each aspect of the indicator.

(2)Research Implementation: At this stage, researchers will carry out learning activities in the classes that are used as research samples, namely providing *Problem Based Learning* model treatment in experimental classes and conventional model treatment in control classes. After being treated, students in the experimental class and control class will be given a post-test at the end of the meeting.

(3)Research Reporting: At this stage, researchers began processing data and writing research reports. Data analysis was carried out using *independent sample t test*. After previously conducted prerequisite tests, namely *normality test* and *homogeneity test*.

3. RESULTS AND DISCUSSION

3.1. Results

a. Deskription of Post-test Result

The post-test was given to students after researchers gave treatment in experimental and control classes. The purpose of giving this post-test is to determine the success of Problem Based Learning model used to improve students' computational thinking skills on the material that has been taught.

From table 2, it is known that the average value (mean) obtained by the experimental class is higher than the control class, namely 75.96 in the experimental class and 53.50 in the control class.

Table 2. Data Description of Post-test Results

Statistics	Class	
	Experiment	**Control**
Mean	75.96	53.50
Minimum	46	25
Maximum	100	75
Std. Deviation	14.322	15.766
Variance	205.123	248.556

As well as the minimum and maximum values in the experimental class are higher than the control class. Thus, it can be ascertained that the PBL-treated class is superior in terms of computational thinking skills.

b. Computational Thinking Ability Test Analysis

Before the analysis test is carried out, first the prerequisite analysis test is carried out using the normality test and homogeneity test.

Table 3. Normality Test Results

Class	Kolmogorov-Smirnov[a]		
	Statistic	**df**	**Sig.**
Experiment Class	.088	25	.200*
Control Class	.126	28	.200*

The table 3 shows that the results of the post-test data normality test on experimental and control class students using *Kolmogorov-Smirnov* test obtained a sig. value of 0.200. Because the test results are sig. >0.05, the post-test data is normally distributed.

Table 4. Homogeneity Test Results

Levene Statistic	df1	df2	Sig.
.432	1	51	.514

The table 4 shows that the results of the homogeneity test of student post-test data in the experimental class and control class obtained a sig value. 0,514. Because the test results are sig. >0.05 then the data varies homogeneously. Based on the normality and homogeneity tests, the analysis test can be carried out.

Table. 5 *Independent Sample t Test* Results

Independent Samples Test				
		t-test for Equality of Means		
		t	**df**	**Sig. Two-Sided p**
Post-test Score	Equal Variances assumed	5.404	51	<,001
	Equal Variances not assumed	5.434	50.981	<,001

The table5 shows that the sig. <0,001. Based on decision making if the sig value. >0.05 then H_0 is accepted and H_a is rejected, and vice versa. Because the sig value. 0.001 <0.05 then H_0 is rejected and H_a is accepted, this shows that there is a significant effect of using *Problem Based Learning* model on mathematical computational thinking skills.

Table 6. Effect Size

Independent Samples Effect Sizes			
Standardizer[a]	**Point Estimate**	**95% Confidence Interval**	
		Lower	**Upper**
15.104	1.487	.870	2.093

Based on Cohen's interpretation, the effect size is 1.487. This shows that *Problem Based Learning* model has a greater influence on students' mathematical computational thinking skills.

3.2. Discussion

Based on the results of the research conducted by the researchers, the use of Problem Based Learning model in learning affects the students' mathematical computational thinking ability. During the learning process, the experimental class that used the Problem Based Learning model looked enthusiastic and excited until the end of the lesson. In the control class, students tended to be passive and lackluster.

Based on the observations that the researchers made, namely in the application of PBL learning methods and students' responses to them, as well as identifying the difficulties faced by students and how they overcame them, the steps in the Problem Based Learning model were able to influence the learning process. In the problem orientation stage and organizing students in learning, students are able to identify problems which then write what is known and asked in the given problem. At the stage of guiding the investigation, students play an active role in group discussions so that it raises high curiosity in students and students become motivated to solve problems. At the stage of developing and presenting results and analyzing and evaluating results can increase student confidence. Students are also enthusiastic when they want to present the results. This can be seen when group representatives compete to present the results of their group's work. During the learning process, students also did not hesitate to ask questions if there were things they did not know.

From the two classes studied, it can be seen that the Problem Based Learning model can create active learning. From the discussion, students are able to identify and find information and solve problems based on that information. This kind of learning can improve students' mathematical computational thinking skills in identifying problems and finding solutions to these problems through the process of thinking and discussing. With increased computational thinking skills, students can develop their ability to find weaknesses or errors in solutions and correct them quickly as stated by Christi & Rajiman (2023). Based on this description, it can be concluded that the use of Problem Based Learning model affects students' mathematical computational thinking ability.

4. CONCLUSION

Based on the results of the research and discussion that has been presented, it can be concluded that there is an effect of *Problem Based Learning* model on students' mathematical computational thinking skills. From the average post-test results, the

experimental class has a higher value than the control class. From the results of hypothesis testing, it shows the sig value. <0.001, the value is smaller than 0.05. From the results of the *effect size* obtained of 1.487. Thus, H_0 is rejected and H*a* is accepted. This shows that there is an effect of *Problem Based Learning* model on students' mathematical computational thinking skills.

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