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The Influence of the Game Based Learning Model on Students' Mathematical Conceptual Understanding

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Abstract

One material that has a high level of difficulty and abstractness is spatial construction material. Students have difficulty understanding mathematical concepts in this material. This research operationally aims to determine the effect of the Game Based Learning (GBL) learning model on students' understanding of mathematical concepts in class VIII cubes and blocks at SMPN 05 Cikarang Selatan. This research uses a quantitative approach with a quasi-experimental method. The population in this study was all class VIII students at SMPN 05 Cikarang Selatan, totaling 359 students with a sample of 80 students obtained using the Cluster Random Sampling technique. The instrument used to collect data was an essay test, in accordance with indicators of understanding of mathematical concepts, the main topic of data presentation was 8 questions. So it can be concluded that the GBL learning model influences students' understanding of mathematical concepts in class VIII cubes and blocks at SMPN 05 Cikarang Selatan.

Keywords: Game Based Learning, Learning model, Mathematical conceptual understanding.

1 INTRODUCTION

In education, mathematics is taught at elementary school to high school level. Mathematics is also always encountered in everyday life and mathematical concepts are also often used in solving problems. If mathematics is often applied in everyday life then basically student learning outcomes in mathematics lessons at school will also be good. But in reality there are still many students who have difficulty learning mathematics. This is based on the results of the Program for International Student Assessment (PISA) for Indonesia in 2018 announced by the Organization for Economic Co-operation and Development (OECD). OECD members for mathematics 489. Meanwhile, Indonesia itself received a mathematics score of 379.

In learning mathematics, many students fail in this lesson. Some of the causes are that students do not understand mathematical concepts or students misunderstand mathematical concepts. Apart from that, there is a lack of variety in how to convey learning in mathematics, which makes students less interested in learning. This continues in the mathematics learning process which creates a passive learning situation for students and this results in low understanding and gives rise to the idea that mathematics is a lesson that is difficult to understand and boring. Not a few students get low grades in mathematics. This can be seen from the average mathematics score from the National Examination and the level of mastery of junior high school material in Bekasi Regency in 2018 and 2019 on the Ministry of Education and Culture's educational assessment center website.

The average score on the national mathematics exam, specifically in Bekasi Regency, is ranked 21st with an average of 41.58. The low average score in mathematics in Bekasi Regency is possible because the level of mastery of some mathematics material is still

low. This data shows that junior high school students in Bekasi Regency have difficulty learning geometry and geometric material, which affects student learning outcomes and achievement. One of the materials in geometry and measurement is spatial shapes.

Space building material requires students' understanding of mathematical concepts in the learning process. If students have a very poor understanding of mathematical concepts, the result is that students will have difficulty solving questions and determining the answers. Students' understanding of mathematical concepts can be seen as one of the learning processes and outcomes. Understanding mathematical concepts is very important for students to learn mathematics because understanding mathematical concepts is the initial stage in being able to solve a mathematical problem that is found (Nurhairunnisah & Sujarwo, 2018; Pujakusuma & Pramuditya, 2023). Understanding mathematical concepts is important for students to have because this understanding is something that must be present in someone to have mathematical problem solving abilities. In this study, researchers took spatial material, namely cubes and blocks, from class VIII students.

Based on the results of a survey conducted by researchers, the quality of learning outcomes shows that class VIII students at SMPN 05 Cikarang Selatan in learning mathematics, especially in understanding mathematical concepts, students still have low or not fully optimal understanding of mathematical concepts. Low understanding of mathematical concepts for students at SMPN 05 South Cikarang was shown when the initial observation was carried out, where some students were still unable to solve the problem on the initial observation questions given. These problems require efforts to improve the quality of mathematics learning, including considering changes in the learning process. One of them is by changing the learning model. In this case, it requires an interesting learning model that can motivate students to learn. According to Shi and Shih (2015), the GBL learning model is a learning model with games that can increase student motivation and make students more effective in learning.

The application of the GBL learning model in mathematics learning in previous research was carried out (Shi & Shih, 2015; Chen et al., 2021). Comprehension is a process of understanding a certain meaning or significance and the ability to use it in other situations (Yonanda, 2017). Apart from that, GBL can increase student activity and improve student learning outcomes (Shi & Shih, 2015; Chen et al., 2021; Tokac, Novak, & Thompson, 2019). By the way, this research focuses on discussing the understanding of mathematical concepts in cubes and blocks. In learning cubes and blocks, understanding mathematics is very important so that we are expected to be able to understand mathematical concepts well. As educators, you must innovate and use diverse learning models.

Based on the theory above, this research will discuss problems that arise in mathematics learning, including whether there is an influence of the GBL learning model on students' understanding of mathematical concepts in cube and block material for Class VIII SMPN 05 Cikarang Selatan.

2 RESEARCH METHODS

This research uses a quantitative approach with a quasi-experimental method carried out at SMPN 05 Cikarang Selatan. With the Posttest Only Control Group Design, it can be seen in Table 1.

Table 1. Design Scheme Posttest Only Control Group

Learning group	Treatment	Posttest
Experiment	X	T_2
Control	-	T_2

Note: X=treatment using the GBL model; T_2=posttest.

The population of this research is all class VIII students at SMPN 05 Cikarang Selatan for the 2022/2023 academic year, totaling 359 students. The samples in this research were taken using Cluster Random Sampling. In order to collect data in this research, test techniques were used referring to indicators of understanding of mathematical concepts in the data presentation material. The form of the test given is in the form of 8 essay questions discussing data presentation.

3 RESULT AND DISCUSSION

The results of this research are data on students' mathematical concept understanding test scores as a result of implementing the GBL learning model in the experimental class and conventional learning in the control class. Students' understanding of mathematical concepts scores were obtained through post-test. The description of the results consists of seven stages, namely: validation test, reliability test, difficulty level test, differential power test, normality test, homogeneity test, and hypothesis test.

The results of the validity test of the instrument were tested using Ms. Excel and manual calculations on essay questions for students' understanding of mathematical concepts in cubes and blocks resulted in 8 valid questions and 1 invalid item. The results of the reliability test of the instruments that have been tested are 0.6181 with sufficient category criteria. The results of the difficulty level test obtained results with medium criteria for 8 questions. The results of the different power test with 8 questions are sufficient criteria.

3.1 Prerequisite test results Data analysis

As a result of the research, the normality test results for the experimental class L_{count}=0.1257<L_{table}=0.1400 and the control class normality test L_{count}=0.1179<L_{table}= 0.1400 concluded that the data were normally distributed. The results of the homogeneity test obtained F_{count}=1.1102<F_{table}=1.7044, so the data variance comes from a homogeneous group.

Hypothesis test results to see the influence of the GBL learning model on students' understanding of mathematical concepts in class VIII cubes and blocks at SMPN 05 Cikarang Selatan. The results obtained t_{count}=2.9851>t_{table}=1.6646 means that there is an influence of the GBL model on understanding mathematical concepts in class VIII cubes and blocks at SMPN 05 Cikarang Selatan.

3.2 Normality test

The normality test is carried out to assess the distribution of data in a group of data or variables that are normally distributed or not. The results of the normality test calculations can be seen in Table 2.

Table 2. Normality Test Results

Learning group	n	α	L_{count}	L_{table}	Conclusion
Experiment	40	0.05	0.1257	0.1400	Normal
Control	40	0.05	0.1179	0.1400	Normal

Based on Table 2, it shows that the data comes from the experimental class and the control class L_{count}<L_{table} because 0.1257<0.1400 and 0.1179<0.1400, so it can be concluded that the normality test results on the post-test data are normally distributed.

3.3 Homogeneity Test

The homogeneity test in this research is used to ensure that the data group comes from a population that has the same variance (homogeneous). The results of the homogeneity test calculation can be seen in Table 3.

Table 3. Homogeneity Test Results

Class	Variance	*dk*	F_{count}	F_{table}	Conclusion
Experiment	179,16	39	1.1102	1.7044	Homogeneous
Control	177,74	39			

Based on Table 3, the values obtained F_{count}=1.1102 and F_{table}=1.7044. These results show that $F_{count}<F_{table}$, it can be concluded that the experimental class and control class have the same or homogeneous variance.

3.4 Hypothesis testing

After the data analysis is completed, the hypothesis test is then carried out using the t-test. The results of hypothesis testing using the *t*-test are presented in Table 4.

Table 4. Hypothesis Test Results

Class	$\bar{x}$	N	S^2	S_{gab}	t_{count}	t_{table}
Experiment	70,7	40	179,16	14,91	2,9851	0,1852
Control	63,82	40	177,74			

Based on Table 4, it shows that t_{count}=22.9851 and t_{table}=0.1852. Therefore $t_{count}>t_{table}$, it can be concluded that there is an influence of the GBL model towards understanding mathematical concepts.

3.5 Discussion of the findings

Understanding mathematical concepts in mathematics learning is an important thing in mathematics learning. Students' understanding of mathematical concepts in this research was built using the GBL model. GBL is a learning model with games used in learning. The advantages of this GBL model are that students interact and play a direct role in learning, foster a sense of solidarity and togetherness, motivate and involve all students in learning, as a therapeutic medium to overcome cognitive difficulties, students are stimulated to be active, think logically, sportsmanship and feeling happy and satisfied in learning, learning material is easier to understand and easier to remember and is related to students' understanding of mathematical concepts, increasing effectiveness in learning. Looking at these advantages, the aim of this research is to increase students' understanding of mathematical concepts using the GBL model by providing questions in the form of essays.

Based on the results of research hypothesis testing (*t*-test), it was found that the t count was greater than the t table and the average of the experimental class using the GBL model got 70.7 and the average of the control class using the conventional learning model got 62. 82, it can be concluded that there is an influence of the GBL model on students' understanding of mathematical concepts in cube and block material in class VIII SMPN 05 Cikarang Selatan. This is supported a study by Maulidina, Susilaningsih, and Abidin (2018) which has proven that GBL can facilitate increased student motivation in learning and is able to stimulate children's emotional, intellectual and psychomotor skills. Brezovszky et al. (2019) informed that GBL is a learning model that is often used by educators because it can improve mastery of material and understanding of mathematical concepts.

4 CONCLUSION

Based on the results of the research that has been carried out, it can be concluded that there is an influence of the GBL model on students' understanding of mathematical concepts in class VIII cubes and blocks at SMPN 05 Cikarang Selatan. This can be seen from the experimental class average of 70.7 and the control class average of 62.82 and

the hypothesis test calculations$H1$ accepted. Thus, these results indicate that there is an influence between the GBL model and students' understanding of mathematical concepts.

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