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The Influence of the TGT Model Assisted by the Plickers Application Media on Understanding Mathematical Concepts

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Abstract

This study aims to analyze the effect of the Teams Games Tournament (TGT) learning model assisted by the Plickers application media on the understanding of mathematical concepts of second-semester students of the Bachelor of Mathematics Education, University of Bengkulu. This type of research is a quasi-experimental study with a non-equivalent pretest-posttest control group design. The population in this study were all second-semester students of the Bachelor of Mathematics Education, University of Bengkulu in the 2023/2024 academic year. The sample of this study was taken using a purposive sampling technique where 30 students from the second semester of Class A were taught using the Teams Games Tournament (TGT) model assisted by the Plickers application and 32 students from the second semester of Class B were taught using the direct learning model. Data collection was carried out using a mathematical concept ability test instrument. The results of the hypothesis test showed that the sig value (2-tailed) was 0.000 <significant level (α) = 0.05 and supported by an N-Gain of 0.581 with a moderate category. Therefore, it can be concluded that there is a significant influence of the Teams Games Tournament model assisted by the Plickers application media on the mathematical concept understanding ability of 2nd semester students of the Bachelor of Mathematics Education program at the University of Bengkulu.

Keywords: *Teams Games Tournament (TGT), Plickers, Mathematical Concept Understanding*

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Introduction

Mathematics learning is a teacher's effort to encourage students to improve their understanding of mathematics (Abi et al., 2022). According to the National Council of Teachers of Mathematics (2000), mathematics learning requires a strong understanding of what is needed to be learned in order to successfully meet learning requirements. One of the objectives of the mathematics learning curriculum stated in the Minister of National Education Regulation Number 22 of 2006 (Yuliyanto et al., 2019) is "Understanding mathematical concepts, explaining the relationships between concepts and applying concepts or algorithms, flexibly, accurately, efficiently, and appropriately in problem solving." The ability to understand mathematical concepts is one of the skills that students must have in mathematics learning, based on the objectives of mathematics learning.

Mathematical conceptual understanding encompasses students' ability to master material, understand concepts in depth, and be able to apply them well in mathematical learning situations (Yuliani et al., 2018). The application of this conceptual understanding can cover various topics in the curriculum and has a significant impact on various aspects of education (Mills, 2016). Furthermore, the NCTM (The National Council for Teachers of Mathematics) emphasizes the importance of teaching conceptual understanding in mathematics on the grounds that in the 21st century, students need to have conceptual understanding to develop and become individuals capable of solving problems in an ever-changing environment (Rahmat et al., 2018). This statement strongly reinforces the fact that conceptual understanding is closely related to mathematics learning, especially to keep up with the times. Thus, it means that students are accustomed to being able to understand something correctly.

Interviews with mathematics teachers at the University of Bengkulu's Bachelor of Mathematics Education program revealed that students still lack a grasp of the concepts involved in learning. The final semester assessment for the second semester of the Bachelor of Mathematics Education program at the University of Bengkulu only achieved a score of 60.33. Of the 62 students in the second semester, only 21 students (33.87%) had completed the course. Observations also revealed that students had difficulty working on problems that differed from the examples provided. To achieve good mathematical skills, it is important to have a good understanding of mathematical concepts. Understanding mathematical concepts is the main foundation for achieving satisfactory learning outcomes in the final evaluation.

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One way to address these issues is to implement a more interactive learning model that actively engages students in the learning process. A learning model is a conceptual framework used to design and implement the learning process, organizing learning experiences with the goal of achieving specific skills or learning objectives. Furthermore, a learning model also serves as a guide in the learning process by providing systematic learning steps (Suprihatiningrum, 2017). Various learning models exist, including the cooperative Teams Games Tournament (TGT) model.

The Teams Games Tournament (TGT) model is a cooperative learning strategy developed by De Vries and Slavin in 1978 at Johns Hopkins University. The goal of this model is to help students review and master course material through a teamwork- and game-oriented approach. Slavin found that implementing TGT successfully improved basic skills, academic achievement, positive interactions between students, self-esteem, and acceptance of students with differences (Nurhayati & Marliani, 2019:408). The TGT learning model can encourage student engagement in the course material, transforming students from initially passive to active participants in the learning process (Rahmi et al., 2021).

The TGT learning model is a cooperative learning model that differs from other cooperative models. The difference between the TGT model and other cooperative models lies in the tournaments conducted by students. A series of tournaments in the TGT model involves students competing against each other to achieve the highest score and competing against other students with similar academic abilities. Furthermore, games and academic tournaments increase students' enthusiasm for learning and create a positive competitive atmosphere. This makes students happy and avoid boredom in learning because they are given strategies and settings for competition (Rosidin, 2019).

With the development of technology, various media have emerged to support the learning process, one of which is Plickers. Plickers is an application for smartphones or mobile devices and is available as a website. Plickers is a tool used by teachers to provide assessments and collect real-time data from assessment results while creating a fun atmosphere (Yunita et al., 2021). Based on research conducted by Solmaz & Cetin (2017), Plickers is the interactive media most favored by students. Plickers provides an opportunity for students to play an active role in the learning process because the assessment is presented like a game.

The influence of the TGT learning model on students' mathematical concept comprehension needs to be observed and evaluated because this helps ensure that the adopted

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learning approach produces the desired results and aligns with educational objectives. Previous research has shown that TGT-type cooperative learning assisted by online games can improve students' mathematical concept comprehension and reasoning (Rohmah & Wahyudin, 2019). Other research also shows a significant influence of the TGT learning model assisted by teaching aids on students' mathematical concept comprehension (Rahmi et al., 2021). This model is a cooperative learning model where students discuss to gain information or knowledge and practice before competing (Ariani & Agustini, 2018).

Research Method

Types of research

Quantitative methods were used in this study with a quasi-experimental model.

Population and Sample

Second-semester students of the Bachelor of Mathematics Education program at the University of Bengkulu served as the population of this study. The sampling process used a purposive sampling technique. Second-semester students from Class B and Class A served as the sample.

Procedure

This research began with observations in the Undergraduate Program in Mathematics Education at the University of Bengkulu. The study consisted of two groups: an experimental group and a control group. The control group used a direct learning model, while the experimental group used a Teams Games Tournament (TGT) learning model supported by the Plickers application. The research design schematic is shown in the following table:

Table 1. Quasi-Experimental Research Design

Class	*Pre-test*	Treatment	*Post-test*
Experiment	*O1*	X	*O2*
Control	*O3*		*O4*

Source:(Lestari & Yudhanegara, 2015:139)

Data collection technique

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In this study, the researchers used data collection techniques through interviews and tests on students' conceptual understanding. The tests were presented in the form of descriptive questions, with scores assigned according to achievement levels based on students' written answers on a pretest and posttest.

Data Analysis Techniques

Descriptive analysis was conducted to assess students' conceptual understanding. The data collected included the average, variance, standard deviation, and maximum and minimum scores. In addition to descriptive analysis, an inferential analysis was conducted to assess data homogeneity and normality, and a t-test was conducted to assess the effect of Teams Games Tournament (TGT) learning using the Plickers application on students' conceptual understanding in second-semester undergraduate mathematics education programs at the University of Bengkulu. The research hypotheses are as follows:

$H_0 : \mu_1 = \mu_2$; There is no influence of the use of the Teams Games Tournament (TGT) learning model assisted by the Plickers application media on the understanding of mathematical concepts of 2nd semester students of the Bachelor of Mathematics Education program at the University of Bengkulu.

$H_1 : \mu_1 \neq \mu_2$;There is an influence of the use of the Teams Games Tournament (TGT) learning model assisted by the Plickers application media on the understanding of mathematical concepts of 2nd semester students of the Bachelor of Mathematics Education, University of Bengkulu.

The decision-making criteria for testing the data are as follows:

1. If the significance value is <0.05 then it is rejected.H_0
2. If the significance value is ≥ 0.05 then it is acceptedH_0

Results and Discussion

Based on the results of the research that has been carried out, experimental class data was obtained, as well as a description of the mathematical concept understanding ability test in Table 1 below:

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Table 2. Description of Concept Understanding Ability of Experimental Class

Statistics	Experimental Class	
	Pretest	*Posttest*
Many Students	30	30
Average	52.33	80.17
Median	52.50	80
The highest score	75	95
Lowest Value	30	65
Standard Deviation	12,438	7.25
Variance	154,713	52,557
Skewness	-0.375	-0.353

Based on Table 2, it can be seen that the average pretest mathematical concept understanding ability of students in the experimental class was still below 76, namely 52.33. After being given treatment, the average mathematical concept understanding of students increased by 53.20%. The standard deviation of the data in the experimental class from pretest to posttest decreased, indicating a change in students' conceptual understanding ability before and after the treatment was given.

As for the description of the test of mathematical concept understanding ability of the control class, it can be seen in Table 3.

Table 3.Description of Control Class Concept Understanding Ability

Statistics	Control Class	
	Pre-test	*Post-test*
Many Students	32	32
Average	50.16	63.59
Median	50.00	65.00
The highest score	70	80
Lowest Value	35	50

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Standard Deviation	9,712	9.09
Variance	94.33	82,636
Skewness	0.376	0.241

Based on Table 4.3, it can be seen that the average mathematical concept understanding ability of students in the control class before and after being given treatment has not yet reached a value of 76. The description of the control class data shows that the standard deviation of the pretest-posttest is almost the same, which means that there is almost no change in students' concept understanding ability before and after the treatment is given.

To determine the effect of the TGT learning model using the Plickers application on students' mathematical conceptual understanding, a hypothesis test was conducted based on the research results. The data used were the pretest and posttest scores of students' mathematical conceptual understanding in the experimental and control classes.

1. Normality Test

The results of the normality test can be seen in Table 4 below:

Table 4. Data Normality Test

Class	Test Types	Sig Value	Real Level	Information
Experiment	*Pre-test*	0.074	0.05	H_0accepted
	Post-test	0.075	0.05	H_0accepted
Control	*Pre-test*	0.063	0.05	H_0accepted
	Post-test	0.077	0.05	H_0accepted

Based on Table 4, it was found that the pretest and posttest results in the experimental class and control class had significant values greater than the significance level () = 0.05, so

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they were accepted and rejected, so it can be concluded that the pretest-posttest data for the experimental class and also the control class were normally distributed.$\alpha H_0 H_0$

2. Homogeneity Test

The results of the homogeneity test can be seen in table 5.

Table 5. Pretest Data Homogeneity Test

*SPPS Software*23		*Excel*		
Sig Value	Real Level	F_{hitung}	F_{tabel}	Note
0.132	0.05	0.610	1,848	H_0accepted

Based on Table 5. with calculations using SPPS 23 Software, it can be seen that 0.132 > 0.05, which means sig. > significance level () and calculations using Microsoft Office Excel obtained a valueα0.610 < 1.848 which means$F_{hitung} \leq$, then it can be concludedF_{tabel} H_0accepted, meaning the pretest group data is the same (homogeneous).

Table 6. Posttest Data Homogeneity Test

*SPPS Software*23		*Excel*		
Sig Value	Real Level	F_{hitung}	F_{tabel}	Note
0.086	0.05	1,572	1,848	H_0accepted

Based on Table 5. with calculations using SPPS 23 Software, it can be seen that 0.086 > 0.05, which means sig. > significance level () and calculations using Microsoft Office Excel obtained a valueα1.572 < 1.848 which means$F_{hitung} \leq$, then it can be concludedF_{tabel} H_0accepted, meaning the posttest group data is the same (homogeneous).

3. Hypothesis Testing

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Hypothesis testing was conducted using the Independent Sample t-Test with the help of SPSS software, significance level = 0.05, and Microsoft Office Excel. The results can be seen in Table 7 below:α

Table 6. Data Hypothesis Testing

SPPS		*Excel*		
Sig	Real Level	T_{hitung}	T_{tabel}	Note
0,000	0.05	7,903	2.00	H_0Rejected

Based on Table 6, it appears that the value < significant level is 0.000 < 0.05 and is -2.00 < 7.903 > 2.00, so it is rejected and accepted, so it can be concluded that there is a significant influence of the Teams Games Tournament learning model assisted by the Plickers application media on the ability to understand mathematical concepts of 2nd semester students of the Bachelor of Mathematics Education, University of Bengkulu.$Sig\ (2-tailed) - t_{tabel} < t_{hitung} > + t_{tabel}$$H_0H_1$

The next step is to find out how much improvement is achieved from using the TGT learning model assisted by the application.*Plickers*and direct learning models for the ability to understand mathematical concepts can use tests. The calculation of values in this study uses the help of$N-GainN-Gain$*Microsoft Office Excel*with the following results:

Table 7. Calculation of N-Gain Value

Class	Student	$N-Gain$	Category
Experiment	30	0.581	Currently
Control	32	0.248	Low

Based on Table 7, the value obtained is$N-Gain$The experimental class was 0.581, categorized as moderate and interpreted as quite effective. This means that overall, the students in the experimental class experienced an increase in their ability to understand mathematical concepts from before to after being taught with the Team Games Tournament (TGT) model assisted by the Plickers application media.

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While the results of the control class were at 0.248 which was in the low category and the interpretation was ineffective, it can be concluded that the increase in students' mathematical concept understanding ability in the control class was in the low category so that the direct learning model was not effective in improving students' mathematical concept understanding ability. Thus, we can conclude that the class taught with the Teams Games Tournament (TGT) learning model assisted by the Plickers application media was more effective than the direct learning model in improving students' mathematical concept understanding.$N - Gain$

This TGT learning model divides students into various groups, consisting of four to five students. All group members are involved in completing tasks, and there are games and competitions carried out using the Plickers application media. Students are trained to communicate with each other, interact and work together. Learning activities like this can provide direct experience to students so that the knowledge they have gained lasts a long time(Ulfa, 2021)This is due to the TGT learning steps assisted by Plickers media which influence students' ability to understand mathematical concepts.

The class presentation stage involves the teacher explaining the material, and students listen attentively and ask questions about anything they don't understand. Students' enthusiasm is evident when the teacher reminds them of previous material. This situation demonstrates students' efforts to restate concepts they already understand in their own words. The next stage, teams, involves discussion activities, answering questions posed by the teacher. This indirectly requires students to be able to use, utilize, and select specific procedures or operations to solve problems.

At the games stage, students play the game in groups.Each group works together to answer questions using Plickers cards.This game uses the help of the Plickers application media. The game makes learning fun, attracts attention and increases students' learning motivation.(Lestari et al., 2018)At this stage, students discuss and work on problems, which indirectly improves their mathematical concept understanding gradually.

The next stage is the tournament. In this activity, students answer questions individually to earn points (scores) for their group..At this stage, students indirectly improve their ability to understand mathematical concepts by answering the questions given. The final stage is team

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recognition. Here, awards are given to the group with the highest score. These awards further challenge students to understand the material and work on the problems or questions given in the next meeting. Supported by the opinion ofSyahroni (2021)which states that giving awards has an impact on learning motivation and development as well as the emotional bond between teachers and students.

The results of this discussion show that TGT learning using the Plickers application in mathematics indicates good potential for improving students' understanding of mathematical concepts. This improvement in mathematical concept comprehension among students using TGT learning with Plickers is due to the learning procedure emphasizing students' active participation in constructing their understanding. Through TGT learning, students are encouraged to work together effectively within their groups. This collaboration means that each member must help each other.

During the learning process, students with higher abilities help students with lower abilities understand the material, so that the lower-ability students do not withdraw during the learning process and their learning outcomes improve. This is in line with research findings that indicate that TGT cooperative learning can increase students' activeness and ability to understand mathematical concepts.(Rahmi et al., 2021; Rohmah & Wahyudin; Rosidin, 2019)

Conclusion

Based on the hypothesis testing conducted, the calculation results obtained with a significant t value of 0.000 less than the significance level of 0.05 and supported by an N-Gain value of 0.581 with a fairly effective increase, it can be concluded that there is a significant influence of the use of the Teams Games Tournament (TGT) learning model assisted by the Plickers application media on the ability to understand mathematical concepts of 2nd semester students of the Bachelor of Mathematics Education, University of Bengkulu.

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