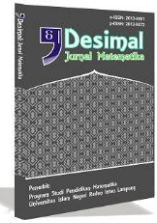




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## Probit Regression Analysis to Improve the Effect of Problem Based Learning Model and Cooperative Type Teams Games Tournament Toward Student Learning Outcomes

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### ABSTRACT

*The aims of the study is to predict the chances of success from the use of the Problem Based Learning (PBL) model compared to the Teams Games Tournament (TGT) Cooperative for student learning outcomes. The research was conducted in 106 Jakarta Senior High School class XI with the Limit of Algebraic Function material. The data were collected by holding a posttest of 5 question descriptions. After the data is collected, it is analyzed using probit regression. The independent variable is the class and the dependent variable is the result of learning. The class independent variable is a dummy variable with a value of "1" it uses PBL method and a value of "0" is a class that uses the TGT cooperative learning model. Furthermore, for the dependent variable of learning outcomes, the value is the chance of success/true of the students in answering the questions given. The resulting probit regression model is the alleged Probit (mathematics learning outcomes) = 1,114 - 0,483 (class). Based on the probit regression model, then at the 5% significance level, it was concluded that the alleged students who received the TGT cooperative learning model had a 13% greater chance of*

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*success/correct in working out the questions compared to students who obtained the PBL, from the results of this study are expected to be suggestions for educators to carry out appropriate learning innovations in achieving student learning outcomes.*

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## INTRODUCTION

Education is the process of learning the knowledge, skills, and habits of a group of people who are passed down from one generation to the next through an atmosphere of teaching and learning, so that the person can develop their potential. According to Dimiyati and Mudjiono in a journal (Indrawan, 2016), education is an action that enables the learning process and development. From the statements described above, it can be concluded that education has an important role in developing and creating the next generation of nations that are intelligent, skilled, and have intellectual abilities to compete with other countries.

To achieve a high level of quality education, it requires a learning system that can develop student achievement. But education in Indonesia, mostly educators have not implemented methods, models, or learning approaches that can stimulate students' learning motivation. Learning activities take place more centered on educators. Some educators argue that learning is only limited to providing knowledge. Students are less interested in

the learning process, causing boredom when educators describe the concept of material. The learning process that takes place cannot be separated from the learning model used, so to improve the quality of education it is necessary to use learning models that are following the material being taught. In applying a learning method correctly and appropriately, according to the needs in the classroom can have a positive impact on improving student learning achievement in Schools (Nasution, 2017).

The learning model that can be applied in class is the Problem Based Learning (PBL) model. PBL as a pedagogical strategy appeals to many educators because it offers an instructional framework that supports active and group learning premised on the belief that effective learning takes place when students both construct ideas through social interactions and self-directed learning (Yew & Goh, 2016). PBL model is an approach to learning mathematics that is contextual in character and facilitates problem-solving (Mahendra, A. E., Caswita, & Bharata,

2019). Barrett in a journal (Rahayu, E. & Hartono, 2016) states that PBL model is learning that results from the process of working to understand problem-solving. Students are actively involved in problem-solving activities such as problem formulation, data collection, data analysis, up to draw conclusions from data. The selection of the learning model is supported by classroom action research that has been carried out showing that the application of the PBL model can improve the learning process and improve student mathematics learning outcomes (Saputri et al., 2019). Other results showed that the average value of minimum completeness criteria achievement before action was 42.8%, the average value after an action in cycle I was 60.0%, and the average value in cycle II was 82.8% (Ariani, 2018).

Besides Problem Based Learning model, learning model that can make students more active in learning are cooperative learning model. According to Slavin in the journal (Yudianto, W. D., Sumardi, K., & Berman, 2014), cooperative learning is a learning model that conditions students to learn, cooperate and actively interact in small groups that meet the five main elements of cooperative learning. Cooperative learning models have various types, one of the learning models that is expected to

improve student learning outcomes in mathematics is by applying cooperative learning models of the types of Teams, Games, Tournaments (TGT). According to Isjoni in the journal (Damayanti, S. & Apriyanto, 2017) said that the TGT type of cooperative learning model is one type of cooperative learning that places students in study groups consisting of 4-6 students who have abilities, types different sexes, and races. According to Wartono et al in the journal (Tiya, 2013) explained that, in TGT or game matches, teams of students play a game of shuffling cards with other team members to get points on their team's score. TGT type of cooperative learning model can be ended with a game or tournament, educators expect students to be able to work together in teams through academic tournaments. Previously, classroom action research had been conducted which explained that the application of the TGT type learning model could improve student learning outcomes (Herdian, S.Pd., 2016). Other results showed that the percentage of mastery learning outcomes in mathematics increased from 63.6% of students who completed the first cycle to 83.3% of students who completed the second cycle (Lestari, S. E. C. A., Hariyani, S., & Rahayu, 2018).

Learning outcomes are the ability skills and attitudes obtained by students after receiving the treatment given by educator, so that they can construct knowledge in daily life. According to Dimyati and Mudjiono in a journal (Sulastri., Imran., & Firmansyah, 2006), learning outcomes are things that can be viewed from two sides, namely the student and educator. In terms of students, learning outcomes are a better level of mental development when compared to before learning. According to Purwanto in the journal (Zulyadaini, 2016), learning outcomes are changes in student behavior due to learning. It can be concluded based on the opinion of some experts that learning outcomes are a process or activity changes in individual behavior in gaining knowledge after getting learning or experience, this is a change that leads to better (positive), for example who did not know after experiencing the learning process at least become know.

When completeness of student learning outcomes is not achieved due to lack of creative educators in delivering learning material, because educators still use lecture method that make students less able to understand the material delivered by educators, as a result students become less active and less

concentrated in the following learning in class. The two models above have in common which is to make the role of students more active in the learning process, but there is a slight difference where the TGT cooperative learning model ends with a game or competition between groups that make students more eager to learn to produce as many scores as possible in each group. In this study, researchers wanted to know the effect of applying PBL model or TGT cooperative learning model to student learning outcomes so that in the future when learning mathematic educators can apply learning method that are more appropriate to get better student learning outcomes.

## **METHOD**

The approach in research is a quantitative approach that emphasizes its analysis of numerical data with statistical method (Rusmawati, P., Candiasa, I. M., & Kirna, 2013). The research used was an experimental study by applying two learning models namely the PBL model and the TGT cooperative learning model with M-G (Matched Group Designs). The population in this study were all students 106 Jakarta Senior High School class XI with the Limit of Algebraic Function material which were registered in the

even semester of the 2019/2020 school year with a total of 7 classes, but the sample used to represent the population was only 2 classes with the same number of students in each class. Selection of class based on homogeneity test.

Table 1. Homogeneity Test

Levene Statistic	df1	df2	Sig.
5.373	1	68	.023

The calculation of the homogeneous test for class XI IPS 1 and XI IPS 4 because it has the same number of students in each class, namely 35 students. Based on the result of the homogeneity test calculation, a significance value of 0.023 is obtained from the data or the Odd Final Semester Assessment value. The significance value is  $0.023 < 0.05$ , so it can be concluded that class XI IPS 1 and XI IPS 4 have the same or homogeneous variant. That way the research can be continued by giving treatment to each class (Sibuea, M. F. L. dan Handayani, 2019).

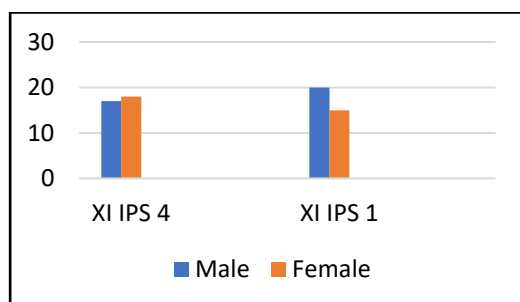


Figure 1. Number of Students in Each Class

Experimental first class is XI IPS 4 consisting of 17 male students and 18 female students with a total of 35 students who will be given PBL model treatment and experimental second class is class XI IPS 1 consisting of 20 male students and 15 female students with a total of 35 students who will be given the TGT Cooperative learning model treatment. In this study, researchers used the Limit of Algebraic Function material. Each class did face to face as much as 8 x 2 hours of learning, the last 1 hour at the 8<sup>th</sup> meeting was to take the value of student mathematic learning outcomes.

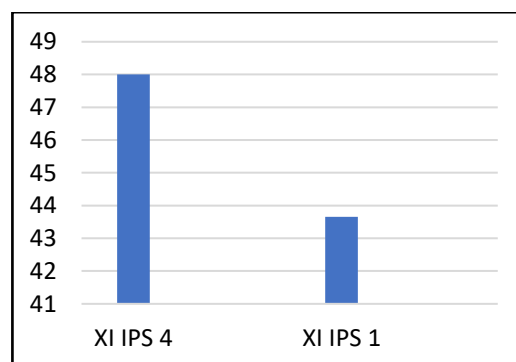


Figure 2. Average Before Treatment

Based on the figure 2 it is found that the average value of the PBL model class is 48 before treatment. It is higher than the TGT Cooperative learning model class is 43.66 with a difference of 4.34.

In the experimental class 1 will be given treatment PBL model, according to Ibrahim in the thesis (Ariani, 2018) that PBL usually consists of five stages, namely:

(1) problem orientation, (2) organizing students to learn, (3) helping individual investigations and groups, (4) develops and presents the work, and (5) analysis and evaluation of problem-solving processes. While the experimental class 2 will be given the TGT cooperative learning model, according to Slavin in the journal (Tiya, 2013) the steps in implementing TGT Type Cooperative learning include: (1) Educator teach as usual, (2) Students learn in heterogeneous groups, (3) Each student goes to a tournament shirt to compete. Each tournament table consists of representatives from each group,

having the same ability, (4) After the game is over, all students return to their respective groups, (5) The educator announces the score of each group and rewards the group that won.

To ensure true result of treatment, it is given up to the taking of students' mathematical learning outcomes carried out simultaneously and closely monitored. the research instrument has been tested for validity and reliability, the number of samples may not change, and the ability and experience educators who conduct experiments are relatively similar.

Table 2. Values of Correlation Pearson for Item 1 – Total Score

	Item 1	Item 2	Item 3	Item 4	Item 5	Total Score
Item 1	1	-0.044	-0.017	0.195	0.423**	0.517**
Item 2	-0.044	1	0.099	0.362*	0.002	0.466**
Item 3	-0.017	0.099	1	0.378**	0.133	0.588**
Item 4	0.195	0.362*	0.378**	1	-0.026	0.678**
Item 5	0.423**	0.002	0.133	-0.026	1	0.573**
Total Score	0.517**	0.466**	0.588**	0.678**	0.573**	1

\*\*: Correlation is significant at the 0.01 level (2-tailed).

\* : Correlation is significant at the 0.05 level (2-tailed).

Based on the table 1, the value of obtained for item 1 is 0.517, item 2 is 0.466, item 3 is 0.588, item 4 is 0.678, and item 5 is 0.573. The value of each question when compared to which has 30 respondents is 0.361 at the 5% level, then

the results given are in item 1  $0.517 > 0.361$ , in item 2  $0.466 > 0.361$ , in item 3  $0.588 > 0.361$ , in item 4  $0.678 > 0.361$ , and in item 5  $0.573 > 0.361$ . Based on the results of the calculation of the validity of the instrument, it was found that the 5

items tested were valid, namely item 1 to 5, the researcher could continue testing the reliability of the items. The result of the calculation of the reliability test, the Cronbach's alpha value is obtained of 0.470. The Cronbach's alpha value  $0.470 < 0.600$ , it can be concluded that the items are included in the medium reliability category so that researchers can use these questions as instruments during the study (Dhamayanti, M., Rachmawati, A. D., Arisanti, N., Setiawati, E. P., Rusmi, V. K., dan Sekarwana, 2017).

Collecting data in this study in the form of quantitative data obtained from the value of mathematic learning outcomes of students after being given a different learning model treatment in each class. The instrument used to measure the value of students' mathematical learning outcomes is an instrument that consists of 5 item descriptions of Limit of Algebraic Function material that has passed the validity and reliability tests. Then the value will be analyzed with probit regression to predict the chances of success from the use of the Problem Based Learning model compared with the Teams Games Tournament Type of Cooperative for student learning outcomes.

Probit regression analysis is an analysis used to see the relationship between the dependent variable that is

categorized (qualitative) and the independent variables that are qualitative or quantitative. The probit model uses the Normal Cumulative Distribution Function (CDF) to explain the equation function. The independent variable of this study is the dummy variable, which is a class given a PBL model notated by the number "1". Classes given the TGT Cooperative learning model is notated with the number "0". Then, the dependent variable is the value of student learning outcomes in the form of a percentage (Marlena, L. & Nugraheni, 2019). In this case, it means that variable Y that is the probability of a student getting the correct answer (success) from the overall score. For example, if the total score is 100, and the student has a correct score of 78, then the Y variable value is equal to  $78/100$  or 78% or 0.78.

The probit regression model can be written as follows:

$$\text{probit}[\pi(x)] = \alpha + \beta_0 + \beta_1 x_1 + \dots + \beta_p x_p$$

Probit regression parameters are  $\beta_i = (\beta_1, \beta_2, \dots, \beta_p)$  and independent variables are  $x_i = (x_1, x_2, \dots, x_p)$  (Agresti, 2007).

Probit regression analysis used is a single probit regression analysis to see the effect of each independent variable individually on the response variable conducted by modeling individually

(Wulandari, E., & Sutanto, 2013). Statistical testing is done to determine the independent variables contained in the model have a real (significant) relationship with the dependent variable with the help of SPSS software.

The partial test is carried out to test the significance of the  $\beta$  coefficient partially by comparing the alleged  $\beta$  with the standard error estimator.

With a hypothesis:

$H_0 : \beta_j = 0$  (The class does not significantly affect the value of students' mathematics learning outcomes)

$H_1 : \beta_j \neq 0$  (classrooms influence the value of students' mathematics learning outcomes significantly)

with Wald-test statistics:

$$W = \frac{\hat{\beta}_j^2}{SE(\beta_j)^2}$$

Information:

$\beta_j$  = Estimator for  $\beta_j$

$SE$  = Standard error estimator  $\beta_j$

W test statistics follow the standard normal distribution, then testing is done by comparing the Wald test statistics with the standard normal distribution at a significant level  $\alpha$ .  $H_0$  is rejected if the value of  $|W| > Z_{\alpha/2}$  or  $p\text{-value} < \alpha$ .

Simultaneous tests were carried out to check the significance of the  $\beta$  coefficient as a whole or simultaneously.

The testing hypothesis:

$H_0 : \beta_1 = \beta_2 = \dots = \beta_p = 0$

$H_1 : \text{there is at least one } \beta_j \neq 0 ; j=1,2,\dots,p$

But because the independent variable used in this study is only one ("class" dummy variable), the overall test hypothesis is no different from the partial test, namely:

$H_0 : \beta_j = 0$  (the class does not significantly affect the value of mathematics learning outcomes of students)

$H_1 : \beta_j \neq 0$  (class influences students' mathematics learning outcomes significantly)

The test statistic carried out is the  $G^2$  test or likelihood ratio test, namely:

$$G^2 = -2 \ln \left[ \frac{\left(\frac{n_1}{n}\right)^{n_1} \left(\frac{n_0}{n}\right)^{n_0}}{\sum_{i=1}^n \hat{\pi}_i^{y_i} (1 - \hat{\pi}_i)^{1-y_i}} \right]$$

Information:

$n_1$  = the number of valuable observations  
 $y=1$

$n_0$  = the number of valuable observations  
 $y=0$

$n = n_1 + n_0$

The  $G^2$  test statistics follow the  $\chi^2$  distribution, then testing is done by comparing the  $G^2$  test statistic value and the  $\chi^2$  table value with free degrees  $v$  (number of parameters) at the significant level  $\alpha$ .  $H_0$  is rejected if the value of  $G^2 > \chi^2(v, \alpha)$  or  $p\text{-value} < \alpha$  (Wulandari, E., & Sutanto, 2013).



According to Hosmer & Lemeshow (1989) in the thesis (Permatasari, 2016) Goodness of Fit Test is used to find out whether there is a significant difference between the regression model and the model predictions.

With a hypothesis:

$H_0$  : Model is appropriate (there is no difference between the regression model and the model predicted)

$H_1$  : Model does not match (there is a difference between the regression model and the results of the model prediction)

Test Statistics:

$$X^2 = \sum_k^g \frac{(O_k - n'_k \bar{\pi}_k)^2}{n'_k \bar{\pi}_k (1 - \bar{\pi}_k)}$$

Where  $O_k$  is the number of response variable values in the k-th observation,  $\bar{\pi}_k$  is the average of estimated probabilities,  $g$  is the number of observations, and  $n'_k$  is the number of subjects in the k-th observation.  $H_0$  is rejected if the value of  $X^2 > X^2_{(\alpha, g-2)}$  or  $p\text{-value} < \alpha$ .

## RESULTS AND DISCUSSION

Based on the results of the final test data of learning outcomes of students on

the Limit of Algebraic Function material in the PBL model class an average value of 73.60 and the TGT Cooperative learning model class obtained an average value of 86.74 so that it has a difference of 13.14. Thus, it can be said that the class applying the TGT Cooperative learning model gets a higher average value.

Table 1. Parameter estimation of probit regression

Parameter	Estimate	Significance
Kelas	-0,483	0,000
Intercept	1,114	0,000

The table 3 explain the probit regression model obtained is as follows: Probit (mathematic learning outcomes) = 1,114 - 0,483 class. Then, the table also shows partial test result for independent variables. "Class" in the column of significance value, which is 0,000. This value is less than the level of significance set at 5%. This shows that at the 5% level, the dummy "class" variable significantly influences the likelihood or opportunity of student learning outcomes.

Table 2. Probit Regression Calculation

Model	Probit (value) = 1,114 - 0,483 class	Standard Normal Table at 5% Level	Z <sub>Tab</sub> × 100%
PBL	= 1,114 - (0,483 × 1) = 0,631	0,7357	74%
TGT	= 1,114 - (0,483 × 0) = 1,114	0,8729	87%

The probit regression calculation table above shows that students who are in the PBL model class have a 74% chance of success in mathematic learning outcomes. Students in the TGT Cooperative learning model class have an 87% chance of success in mathematic learning outcomes.

Table 3. Pearson Goodness-of-Fit

Chi-Square	Df	Significance
1433,011	68	0,000

The significance value obtained is 0,000 < 0.05 so that in testing the suitability of the model, H<sub>0</sub> is rejected. This means that at the 5% level, it can be concluded that the probit regression model in the independent variable class is suitable for estimating the probit values of student learning outcomes.

The results of the analysis above indicate that by applying the TGT Cooperative learning model can improve

student learning outcomes that are influenced by improvements in the teaching process of educator in the classroom as well as several factors including the classroom atmosphere that supports the implementation of learning activities, and also can increase the activities of students in class because the activities of students have been conditioned and directed in accordance with the objectives that have been prepared. The statement is in accordance with the theoretical study and the results of research conducted by (Wahartojo, S., Budiyo, & Usodo, 2016) which states that the mathematic learning achievement of the TGT Cooperative learning model is better than the PBL model because the learning model involves active students and educator as facilitator in accordance with the 2013 curriculum. But in other studies that have been conducted to provide different final results, the study provides a statement that there are

positive differences in the PBL model higher than the TGT learning model (Ridhowati, 2018). The difference in the result of this study may be due to the ability of students to capture material or pedagogical educator women in the implementation of the 2013 curriculum is not good (Wahartojo, S., Budiyo, & Usodo, 2016). From the differences in the result of this study, more research is needed to find out the most effective learning model when learning mathematics takes place.

## CONCLUSIONS AND SUGGESTIONS

Based on the result of the study, it can be concluded that the TGT type Cooperative learning model significantly influences student learning outcomes. Students who were given the PBL model treatment had a 13% lower chance of success in student learning outcomes. Judging from the average score obtained, the class using the TGT Cooperative learning model obtained an average score of 86.74 while the class using the PBL model obtained an average value of 73.60.

From these findings, it is recommended for educators to use the TGT Cooperative learning model to assist the learning process in the classroom. A material that is continuous with the Limit of Algebraic Function material because

this learning model is statistically significant in improving student learning outcomes. Group learning can help students and educators to overcome some of the difficulties in the teaching and learning process, as well as increase students' interest in learning because of the holding of a game or tournament at the end of learning.

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