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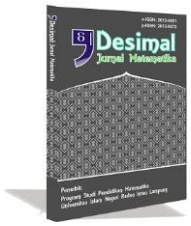

Probit Regression Analysis to Predict the Effect of Problem-Based Learning Model and Teams Games Tournament Cooperative Learning Model toward Students' Learning Outcomes

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ABSTRACT

The study aimed to predict the chances of success from the use of the Problem-based Learning (PBL) model compared to the Teams Games Tournament (TGT) toward students' learning outcomes. The research was conducted to the eleventh-grade students of Senior High School 106 Jakarta on the limit of algebraic function material. The data were collected through a posttest of 5 description questions. After the data had been collected, it was analyzed using probit regression which can provide more information than using just the means of two populations. The independent variable was the class and the dependent variable was the learning outcome. The class independent variable was a dummy variable with the value of "1" which applied the PBL model and the value of "0" was the class that applied the TGT cooperative learning model. The resulting probit regression model was the alleged Probit (mathematics learning outcomes) = 1,114 - 0,483 (class). Based on the probit regression model at the 5% significance level, it can be concluded that the alleged students who were taught using the TGT cooperative learning model had a 13% greater chance of success/correct in working out the questions compared to students who were taught using the PBL. The results showed that the TGT cooperative learning model can improve students' learning outcomes better.

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INTRODUCTION

Education is the process of learning the knowledge, skills, and habits of a group of people passed down from one generation to the next through teaching and learning so that the person can develop their potential. According to Dimyati and Mudjiono (Indrawan, 2016), education is an action that enables the learning process and development. From

the two statements, 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.

The interactive, inspirational, fun, and challenging learning process could motivate students to be active and provide sufficient space for the initiative, creativity, and independence based on their talents, interests, and physical and psychological development (Nurdiansyah, dan Amalia, 2018). However, most of the learning activities tend to be teacher-centered. Some teachers argue that learning that is only limited to providing knowledge makes students less interested in the learning process and bored when the teachers describe the concept of material. With the right learning strategies and techniques, the quality of the learning system and the quality of education can be improved (Mukhid, 2007). Implementing a correct and appropriate learning model based on the needs in the classroom can have a positive impact on improving students' learning outcomes (Nasution, 2018). Thus, to improve the quality of education, appropriate learning models are needed.

The learning model that can be applied in class is the Problem-based Learning (PBL) model. PBL as a pedagogical strategy appalls to many teachers 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 and facilitates problem-solving (Mahendra et al., 2019). Barrett in a journal (Rahayu & Hartono, 2016) states that the PBL model is a learning that is resulted from the process of problem-solving. The advantages of the PBL model include: (1) problem-solving in PBL is helpful to understand the content of a lesson, (2) the problem solving takes place during the learning process that challenges students' abilities and provides satisfaction to students, (3) PBL can increase learning activities, (4) PBL helps the student to understand problems in everyday life, (5) PBL helps students to develop their knowledge and helps them to take responsibility for their learning, (6) PBL helps the students to understand the essence of learning as a way of thinking, not just understanding learning based on textbooks, (7) PBL creates a learning environment that is fun and well-liked by students, (8) PBL is applicable in the real world, and (9) Pbl stimulates the students to learn independently (B. Wulandari & Surjono, 2013). As for the weaknesses of the PBL model, according to Sanjaya in the journal (Tyas, 2017), are (1) If students do not have the belief that the problem being learned is to be solved, they will feel reluctant to try, (2) it needs to be supported by books that can be used in understanding the learning activities, (3) it takes a long time, (4) this model does not apply to many mathematics subjects. One of the classroom action research that has been conducted explains that the application of the PBL learning model can improve the learning process and improve students' mathematics learning outcomes (Saputri et al., 2019). The results showed that the average value of the criteria of minimum mastery before the action research was 66,8%, the average value after the first cycle was 82,8%, and the average value after the second cycle was 95,2% (Pratama et al., 2018). In conclusion, the PBL model can actively involve the students in problem-solving activities such as problem-solving, data collection, data analysis, and concluding the data.

Beside PBL, other learning models that can make students more active in learning are cooperative. According to

Slavin (Yulianto et al., 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 the Teams Games Tournaments (TGT). According to Isjoni (Damayanti & Apriyanto, 2017), TGT cooperative learning model is one type of cooperative learning that places students in study groups consisting of 4-6 students who have different abilities, t sexes, and races. According to Wartono et al (Tiya, 2013), in TGT or game matches, teams of students play a game of shuffling cards with other team members to get points. The advantages of the TGT cooperative learning model are (1) increasing the time spent on assignments, (2) prioritizing acceptance of individual differences, (3) spending less time to master the material in-depth, (4) students playing active roles in the learning process, (5) educating students to socialize with others, (6) improving learning motivation, (7) achieving better learning outcomes, and (8) increasing thinking, sensitivity, and tolerance (Susanna, 2018). The weaknesses of the TGT cooperative learning model according to Suarjana in a journal (Solihah, 2016) are (1) it is hard for teachers to group students who have heterogeneous abilities from an academic perspective and (2) some students have high abilities but find it difficult to explain to their friends. Previously, classroom action research had been conducted which explained that the application of the TGT type learning model could improve students' learning outcomes (Herdian, 2016). Other results showed that the percentage of mastery learning outcomes in mathematics increased from 63.6% to 83.3% after the second cycle (Lestari et al., 2016). Based on this statement, TGT can end with games or tournaments in the hope that students can work together in teams through academic tournaments.

Learning outcomes are the ability, skills, and attitudes obtained by students after receiving the treatment given by the teacher so that they can construct knowledge in daily life. According to Dimyati and Mudjiono in a journal (Sulastri et al., 2015), learning outcomes are things that can be viewed from two sides, namely the student and teacher. In terms of students, learning outcomes are a better level of mental development when compared to before learning. According to Purwanto in a journal (Zulyadaini, 2017), learning outcomes are changes in students' 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 after experiencing learnings. These changes lead to better (positive) directions.

Regarding the strength of the PBL and TGT models, the researchers are interested in comparing PBL and TGT models because, in several previous studies, these models were able to improve students' learning outcomes. The novelty of this study is the use of regression analysis to see the effect of opportunities for the learning models toward students' learning outcomes. The statistical analysis used was Probit regression. According to Finney in a journal (Fathurahman, 2019), probit regression was discovered by Bliss in 1934. According to Bliss, the term "Probit" in probit regression stands for "probability unit" so it can state that Probit regression is a regression model related to unit probability. The probit regression can provide more information than using just two population means. By using Probit regression analysis, the results of this study will be able to provide information about the significant

influence of the learning model toward student learning outcomes. Probit regression can be used to predict the chances of success based on the learning outcomes of students who got the TGT cooperative learning model compared to PBL or vice versa.

METHOD

The approach of this study was the quantitative approach that emphasizes its analysis of numerical data with the statistical method (Rusmawati et al., 2013). The quasi-experimental was employed by applying two learning models, namely the PBL model and the TGT model with matched group designs. The population in this study were all eleventh-grade students of Senior High School 106 Jakarta on the limit of algebraic function material in the second semester of 2019/2020 academic year. The population consisted of 7 classes. However, the sample used to represent the population was only 2 classes with the same number of students in each class. The selection of class was based on a homogeneity test to see whether the sample has the same data or not (Mursalin et al., 2016).

Table 1. Homogeneity Test

Levene Statistic	df1	df2	Sig.
5.373	1	68	.023

The selected classes were class XI IPS 1 and XI IPS 4 because they had 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 was obtained from the data or the scores of the first-semester assessment. The significance value was 0.023 < 0.05, so it can be concluded that class XI IPS 1 and XI IPS 4 had the same or homogeneous variant. After that, the study can be continued by giving treatment to each class (Sibuea, M. F. L. dan Handayani, 2019).

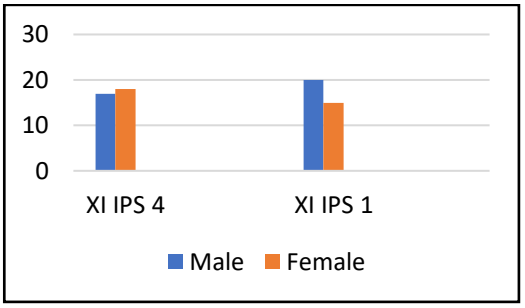

Figure 1. Number of Students in Each Class

The first experimental class was XI IPS 4 which consisted of 17 male students and 18 female students with a total of 35 students to be given PBL learning model treatment and the second experimental class was XI IPS 1 which consisted of 20 male students and 15 female students with a total of 35 students to be given the TGT cooperative learning model treatment. In this study, researchers used the limit of algebraic function material. Each class had 8 x 2 hours of face-to-face meetings. The last 1 hour at the 8th meeting was to take the score of students' mathematic learning outcomes.

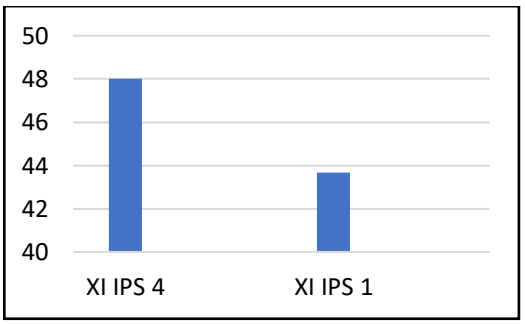

Figure 2. Average Score before Treatment

Based on Figure 2, it was found that the average score of the PBL model class was 48 before treatment. It was higher than the TGT cooperative learning model class which was 43.66 with a difference of 4.34.

The treatment implemented in the first experimental class was the PBL model. According to Arends in a journal (Nafiah & Suyanto, 2014), there are 5 steps

in implementing PBL, namely (1) orienting students to problems, (2) organizing students to research, (3) helping independently and in groups, (4) developing and presenting the work, (5) analyzing and processing the problem. The treatment implemented in the second experimental class was the TGT cooperative learning model. According to Slavin in a journal (Tiya, 2013). the steps in implementing TGT cooperative learning model are (1) teacher teach as usual, (2) students learn in heterogeneous groups, (3) each student join a tournament to compete where each tournament table consists of representatives from each group with the same ability, (4) after the game is over, all students return to their respective groups, and (5) the teacher announces the score of each group and rewards the winning group.

To ensure the true result of treatment, the students' mathematical learning outcomes were taken simultaneously and closely monitored. The research instrument had been tested for validity and reliability, the number of samples may not change, and the ability and the experience of the teachers who conducted the experiments were relatively similar.

Table 2. Values of Pearson Correlation 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 Table 2, the value obtained for item 1 was 0.517, item 2 was 0.466, item 3 was 0.588, item 4 was 0.678, and item 5 was 0.573. The value of each question when compared to 30 respondents was 0.361 at the 5% significance. The results of item 1 were 0.517 > 0.361, item 2 were 0.466 > 0.361, item 3 were 0.588 > 0.361, item 4 were 0.678 > 0.361, and item 5 were 0.573 > 0.361. Based on the results of the validity of the instrument, it was found that the 5 items tested were valid. The researchers could continue testing the reliability of the items. The result of the calculation of the reliability test by employing the Cronbach's alpha was 0.470. The Cronbach's alpha value was 0.470 < 0.600, thus, it can be concluded that the items were included in the medium reliability category so that the researchers could use these questions as instruments (Dhamayanti et al., 2018). The data of this study was in the form of quantitative data obtained from the scores of students' mathematic learning outcomes after being given different learning models in each class. The instrument used to measure the students' mathematical learning outcomes was an instrument that consisted of 5 item descriptions of the limit of algebraic function material that had passed the validity and reliability tests. Then, the scores were analyzed with Probit regression to predict the chances of success based on the comparison of the applied learning models. By using regression analysis, this study revealed the significant effect of the learning models on students' learning outcomes. Then, based on the result of Probit regression analysis, the prediction of chances of success from the learning outcomes of students who got the TGT cooperative learning model compared to the PBL model or vice versa was obtained.

Probit regression analysis is an analysis used to see the relationship between the dependent variable that is categorized as 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 was the dummy variable, namely the class given the PBL model notated by the number "1". Classes given the TGT cooperative learning model was notated by the number "0". Then, the dependent variable was the value of students' learning outcomes in the form of a percentage (Marlena & Nugraheni, 2019). In this case, the variable Y was 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, 78%, or 0.78.

The Probit regression model can be written as follows:

$$probit[\pi(x)] = \alpha + \beta_0 + \beta_1 x_1 + \ldots + \beta_p x_p$$

Probit regression parameters are $\beta_i = (\beta_1, \beta_2, \ldots, \beta_p)$ and the independent variables are $x_i = (x_1, x_2, \ldots, x_p)$ (Alan Agresti, 2018).

Probit regression analysis used was a single probit regression analysis to see the effect of each independent variable individually on the response variable conducted by modeling individually(E. Wulandari & Sutanto, 2013). Statistical testing was done to determine whether the independent variables contained in the model had a real (significant) relationship with the dependent variable with the help of SPSS software.

The partial test had been carried out to test the significance of the β coefficient partially by comparing the alleged β with the standard error estimator with the hypothesis:

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

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

with Wald-test statistics:

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

Description:

β_j= Estimator for β_j

SE= Standard error estimator β_j

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

Simultaneous tests were carried out to check the significance of the β coefficient as a whole or simultaneously with the hypothesis:

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

H_1: There is at least one $\beta_j \neq 0$; j=1,2,...,p

However, since the independent variable used in this study was only one (dummy variable), the overall test hypothesis was 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: $\beta_j \neq 0$ (the class significantly influences students' mathematics learning outcomes)

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

$$G^2 = -2ln\left[\frac{\left(\frac{n_1}{n}\right)^{n_1}\left(\frac{n_0}{n}\right)^{n_o}}{\sum_{i=1}^{n}\hat{\pi}_i^{y_1}(1-\hat{\pi}_i)^{1-y_1}}\right]$$

Description:

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 followed the χ^2 distribution. The testing was done by comparing the G^2 test statistic value and the χ^2 table value with the degree of freedom v (number of parameters) at the significant level α. H_0 is rejected if the value of $G^2 > \chi^2(v, \alpha)$ or *p-value* < α (E. Wulandari & Sutanto, 2013).

According to Hosmer & Lemeshow (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 the 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-value* < α.

RESULTS AND DISCUSSION

Based on the results of the final test data, the PBL learning model class obtained an average value of 73.60 and the TGT cooperative learning model class obtained an average value of 86.74 with a difference of 13.14. Thus, it can be said that the class applying the TGT Cooperative learning model obtained a higher average value.

Table 1. Parameter Estimation of Probit Regression

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

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

Table 2. Probit Regression Calculation

Model	Probit (value) = 1,114 – 0,483 class	Standard Normal Table at 5% Level	Z_{Tab} × 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 shows that students in the PBL model class had a 74% chance of success in mathematic learning outcomes. Students in the TGT Cooperative learning model class had 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 was 0,000 < 0.05 so that in testing the suitability of the model, H_0 was rejected. This means that at the 5% level, the Probit regression model in the independent variable class was suitable for estimating the Probit values of students' learning outcomes.

Based on previous research, the mathematics learning outcomes of the TGT cooperative learning model is better

than the PBL model because the TGT model actively involves students and teachers as facilitators according to the 2013 curriculum (Wahartojo et al., 2016). Previous research has not shown the size of the effect of the chance of success on the TGT cooperative learning model. However, in this research, it was revealed that the effect was 13% greater than the PBL model. Students must also learn to do their work to contribute to their group (Yunita et al., 2020). The results of this analysis indicated that by applying the TGT cooperative learning model, students' learning outcomes can be improved. It can be used in the teaching and learning process to improve students' activeness, higher learning motivation, sensitivity, and tolerance.

CONCLUSIONS AND SUGGESTIONS

Based on the result of the study, it can be concluded that the TGT cooperative learning model significantly influenced students' learning outcomes. Students who were given the PBL learning model treatment had a 13% lower chance of success. Judging from the average score obtained, the class that applied the TGT cooperative learning model obtained an average score of 86.74 while the class that applied the PBL learning model obtained an average value of 73.60.

Based on these findings, it is suggested that teachers use the TGT cooperative learning model to assist the learning process in the classroom on the limit of algebraic function material because this learning model is statistically significant in improving students' learning outcomes. Group learning can help students and teachers to overcome some difficulties in the learning process with less time to master the material in-depth as well as to educate students to practice socializing with others.

REFERENCES

Alan Agresti. (2018). *An introduction to categorical data analysis*. John Wiley & Sons.

Damayanti, S., & Apriyanto, M. T. (2017). Pengaruh model pembelajaran kooperatif tipe TGT (teams games tournament) terhadap hasil belajar matematika. *KPM (Jurnal Kajian Pendidikan Matematika)*, *2*(2), 235–244. https://doi.org/http://dx.doi.org/10.30998/jkpm.v2i2.2497

Dhamayanti, M., Rachmawati, A. D., Arisanti, N., Setiawati, E. P., Rusmi, V. K., & Sekarwana, N. (2018). Validitas dan reliabilitas kuesioner skrining kekerasan terhadap anak "ICAST-C" versi bahasa indonesia. *Jurnal Keperawatan Padjadjaran*, *5*(3), 281–289.

Fathurahman, M. (2019). Pemodelan indeks pembangunan kesehatan masyarakat Kabupaten/Kota di Pulau Kalimantan menggunakan pendekatan regresi probit. *Jurnal Varian*, *2*(2), 47–54. https://doi.org/https://doi.org/10.30812/varian.v2i2.382

Herdian. (2016). Upaya meningkatkan aktivitas dan hasil belajar matematika siswa menggunakan model pembelajaran teams games tournament (TGT) (PTK pada siswa kelas XI SMAN 1 Pagelaran Kab. Pringsewu – Lampung). *Indonesian Digital Journal of Mathematics and Education*, *3*(5), 322–330.

Indrawan, Y. I. (2016). *Studi komparasi penggunaan model pembelajaran problem-based learning dan project based learning terhadap keaktifan siswa kelas X dalam pembelajaran ekonomi SMA Negeri 1 Bangsri tahun ajaran 2015/2016 (Universitas Muhammadiyah Surakarta)*. Universitas Muhammadiyah Surakarta.

Lestari, S. E. C. A., Hariyani, S., & Rahayu,

N. (2016). Pembelajaran kooperatif tipe TGT (teams games tournament) untuk meningkatkan hasil belajar matematika. *Pi: Mathematics Education Journal*, *1*(3), 116–126. https://doi.org/https://doi.org/10.21067/pmej.v1i3.2785

Mahendra, A. E., Caswita, & Bharata, H. (2019). Pengembangan lembar kerja peserta didik berbasis problem based learning untuk meningkatkan kemampuan penalaran matematika. *Desimal: Jurnal Matematika*, *2*(2), 141–146. https://doi.org/https://doi.org/10.24042/djm.v2i2.4238

Marlena, L., & Nugraheni, E. A. (2019). Probit regression analysis in estimating the effect of learning assisted by cabri 3d on students' mathematical understanding ability. *Al-Jabar: Jurnal Pendidikan Matematika*, *10*(2), 319–326. https://doi.org/https://doi.org/10.24042/ajpm.v10i2.4729

Mukhid, A. (2007). Meningkatkan kualitas pendidikan melalui sistem pembelajaran yang tepat. *TADRIS: Jurnal Pendidikan Islam*, *2*(1), 120–133.

Mursalin, W., Bardi, S., & Abdi, A. W. (2016). Pengaruh penggunaan model pembelajaran children learning in science terhadap hasil belajar IPS terpadu di SMP Negeri 1 Meureudu Kabupaten Pidie Jaya tahun ajaran 2015/2016. *Jurnal Ilmiah Mahasiswa Pendidikan Geografi*, *1*(2), 131–144.

Nafiah, Y. N., & Suyanto, W. (2014). Penerapan model problem-based learning untuk meningkatkan keterampilan berpikir kritis dan hasil belajar siswa. *Jurnal Pendidikan Vokasi*, *4*(1), 125–143.

Nasution, M. K. (2018). Penggunaan metode pembelajaran dalam peningkatan hasil belajar siswa. *STUDIA DIDAKTIKA: Jurnal Ilmiah Bidang Pendidikan*, *11*(1), 9–16.

Nurdiansyah, dan Amalia, F. (2018). Model pembelajaran berbasis masalah pada pelajaran IPA materi komponen ekosistem. *PGMI UMSIDA*, 1–8.

Permatasari, D. L. (2016). *Pemodelan ketahanan pangan di Indonesia dengan pendekatan regresi probit ordinal*. Institut Teknologi Sepuluh Nopember.

Pratama, L. D., Lestari, W., & Jailani. (2018). Implementasi pendekatan saintifik melalui problem based learning terhadap minat dan prestasi belajar matematika. *JMPM: Jurnal Matematika Dan Pendidikan Matematika*, *3*(1), 11–21. https://doi.org/https://doi.org/10.26594/jmpm.v3i1.1051

Rahayu, E., & Hartono. (2016). Keefektifan model PBL dan PjBL ditinjau dari prestasi, kemampuan berpikir kritis, dan motivasi belajar matematika siswa SMP. *PYTHAGORAS: Jurnal Pendidikan Matematika*, *11*(1), 1–10. https://doi.org/https://doi.org/10.21831/pg.v11i1.9629

Rusmawati, P., Candiasa, I. M., & Kirna, I. M. (2013). Pengaruh model pembelajaran kooperatif TGT terhadap prestasi belajar matematika ditinjau dari motivasi berprestasi siswa kelas VIII SMP N 2 Semarapura tahun pelajaran 2012/2013. *Jurnal Teknologi Pembelajaran Indonesia*, *3*(1), 1–11.

Saputri, R. I., Alzaber, & Ariawan, R. (2019). Penerapan model pembelajaran problem-based learning (PBL) untuk meningkatkan hasil belajar matematika siswa kelas XI SMA Swasta Bina Siswa. *AKSIOMATIK: Jurnal Penelitian Pendidikan Dan Pembelajaran Matematika*, *7*(2), 83–89.

Sibuea, M. F. L. dan Handayani, M. (2019). Peningkatan hasil belajar dan

motivasi belajar siswa sekolah dasar melalui media pembelajaran monopoli matematika (MONOTIKA). *JURNAL MATHEMATIC PAEDAGOGIC*, *4*(1), 23. https://doi.org/10.36294/jmp.v4i1.761

Solihah, A. (2016). Pengaruh model pembelajaran teams games tournament (TGT) terhadap hasil belajar matematika. *Jurnal SAP*, *1*(1), 45–53. https://doi.org/http://dx.doi.org/10.30998/sap.v1i1.1010

Sulastri, Imran, & Firmansyah, A. (2015). Meningkatkan hasil belajar siswa melalui strategi pembelajaran berbasis masalah pada mata pelajaran IPS di kelas V SDN 2 Limbo Makmur Kecamatan Bumi Raya. *Jurnal Kreatif Online*, *3*(1), 90–103.

Susanna. (2018). Penerapan teams games tournament (TGT) melalui media kartu domino pada materi minyak bumi siswa kelas XI MAN 4 Aceh Besar. *Lantanida Journal*, *5*(2), 93–105. https://doi.org/http://dx.doi.org/10.22373/lj.v5i2.2832

Tiya, K. (2013). Penerapan model pembelajaran kooperatif tipe teams games tournament (TGT) dalam upaya meningkatkan hasil belajar matematika siswa SMPN. *Jurnal Pendidikan Matematika*, *4*(2), 177–197.

Tyas, R. (2017). Kesulitan penerapan problem-based learning dalam pembelajaran matematika. *Jurnal Tecnoscienza*, *2*(1), 43–52.

Wahartojo, S., Budiyono, & Usodo, B. (2016). E*ksperimentasi model pembelajaran PBL, model pembelajaran kooperatif tipe TGT, dan STAD ditinjau dari tingkat aktivitas metakognisi*. Sebelas Maret University.

Wulandari, B., & Surjono, H. D. (2013). Pengaruh problem-based learning terhadap hasil belajar ditinjau dari motivasi belajar PLC di SMK. *Jurnal Pendidikan Vokasi*, *3*(2), 178–191. https://doi.org/https://doi.org/10.21831/jpv.v3i2.1600

Wulandari, E., & Sutanto, H. T. (2013). Model regresi probit untuk mengetahui faktor - faktor yang mempengaruhi jumlah penderita diare di Jawa Timur. *MATHunesa (Jurnal Ilmiah Matematika)*, *2*(1), 1–6.

Yew, E. H., & Goh, K. (2016). Problem-based learning: An overview of its process and impact on learning. *Health Professions Education*, *2*(2), 75–79.

Yulianto, W. D., Sumardi, K., & Berman, E. T. (2014). Model pembelajaran teams games tournament untuk meningkatkan hasil belajar siswa SMK. *Journal of Mechanical Engineering Education*, *1*(2), 323–330. https://doi.org/https://doi.org/10.17509/jmee.v1i2.3820

Yunita, A., Juwita, R., & Kartika, S. E. (2020). Pengaruh penerapan model pembelajaran kooperatif tipe teams games tournament terhadap hasil belajar matematika siswa. *Mosharafa: Jurnal Pendidikan Matematika*, *9*(1), 23–34.

Zulyadaini. (2017). Perbandingan hasil belajar matematika model pembelajaran kooperatif tipe coop-coop dengan konvensional. *Jurnal Ilmiah Universitas Batanghari Jambi*, *16*(1), 153–158.