

## Investigating the Impact of Mobile Legends Gameplay on Students' Academic Performance with Ordinal Logistic Regression

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### ABSTRAK

Perkembangan teknologi informasi dan game online seperti Mobile Legends Bang Bang telah merambah ke berbagai lapisan masyarakat di Indonesia, mulai dari anak-anak, pelajar, hingga mahasiswa. Meskipun pemerintah telah mendukung industri e-sports, penelitian mengenai pengaruh minat bermain Mobile Legends terhadap prestasi akademik siswa masih terbatas. Oleh karena itu, penelitian ini bertujuan untuk mengidentifikasi dampak minat bermain Mobile Legends dan faktor signifikan yang mempengaruhi prestasi akademik siswa. Kami menggunakan metode regresi logistik ordinal dalam analisis kami, suatu teknik statistik untuk mengukur hubungan antara variabel independen dan variabel dependen ordinal, seperti tingkat kinerja akademik yang dikategorikan dalam IPK rendah, sedang, atau tinggi. Analisis kami menghasilkan dua model: Indeks Prestasi Kumulatif (IPK) rendah dan IPK sedang. Faktor yang signifikan adalah tingkat minat yang meliputi kategori 'sangat berminat' dan 'tertarik', serta jenis kelamin dengan kategori 'laki-laki'. Analisis kami juga menunjukkan bahwa model yang diperoleh memberikan hasil yang baik dan dapat diterima karena semua variabel penjelas signifikan secara statistik.

**Kata Kunci :** *Mobile Legends, Game Online, Regresi Logistik Ordinal*

### ABSTRACT

The development of information technology and online games, such as Mobile Legends Bang Bang, has spread to various segments of society in Indonesia, including children, students, and university students. Although the government has supported the e-sports industry, research on the influence of interest in playing Mobile Legends on students' academic performance is still limited. Therefore, this research aims to identify the impact of interest in playing Mobile Legends and the significant factors affecting students' academic performance. We used the ordinal logistic regression method in our analysis, a statistical technique to measure the relationship between independent variables and ordinal dependent variables, such as academic performance levels categorized as low, moderate, or high GPA. Our analysis results in two models: low Cumulative Grade Point Average (GPA) and moderate GPA. The significant factors are the level of interest, including the 'very interested' and 'interested' categories, and Gender with the category 'male.' Our analysis also indicates that the obtained model provides good results and is acceptable since all the explanatory variables are statistically significant.

**Keywords:** *Mobile Legends, Online Games, Ordinal Logistic Regression*

## INTRODUCTION

Technology has undeniably become indispensable to daily life, permeating work, households, education, and entertainment. Devices like smartphones, tablets, and personal computers are now essential tools, particularly for students engaging in online gaming. These games, stemming from the development of information technology, have evolved beyond personal computers, with smartphones and other advanced gadgets offering access to a diverse range of online games. Among these games, genres like role-playing games (RPG), puzzles, and multiplayer online battle arenas (MOBA) have gained immense popularity. MOBA games involve multiple players divided into teams striving to secure victory by dismantling their opponents' unique structures. This game has also transcended mere entertainment and has become the subject of various competitions both at the national and international levels. Indonesian players also have a good reputation in this game, as evidenced by the many Indonesian players on the Leaderboard for Ranked games. Moonton, the developer of Mobile Legends Bang Bang, has honored Indonesian players by creating a hero named "*Gatot Kaca*" as a special tribute (Playstore, 2022).

Government support has played a pivotal role in driving the growth of Indonesia's esports industry, particularly within the community of Mobile Legends enthusiasts. What was once merely a form of entertainment has now transformed into a substantial source of income for numerous individuals. However, many problems have arisen, such as students becoming more focused on playing games than on their studies and the emergence of addictive behaviors. These issues underscore the urgency of examining how playing Mobile Legends impacts students' academic performance. Therefore, it is essential to know how much interest in playing mobile legends games influences students' academic achievement (Iskandar et al., 2019).

There are many statistical methods used to see the influence of an object on other objects, one of which is regression analysis. Various statistical methods, such as ordinal logistic Regression, can help understand the extent of this influence. Using ordinal logistic Regression allows the researchers to understand how the level of interest in Mobile Legends correlates with different academic performance levels, and it provides insights into the strength and direction of this relationship. This method is appropriate for analyzing such relationships when independent and dependent variables are categorical or ordinal, making it a suitable choice for this research. Logistic Regression is a statistical analysis method describing the relationship between a dependent variable with two or more categories and one or more independent variables on a categorical or continuous scale. Logistic Regression can be divided into binary logistic Regression, multinomial logistic Regression and ordinal logistic Regression (Hosmer and Lemeshow, 2000; Supratno, 2000; Gujarati, 2007; Imaslihkah, 2013; Fitriyani et al., 2016; Sugiyono, 2018).

Ordinal logistic Regression is an analytical method used to determine the relationship between dependent and independent variables, where the dependent variable is on an ordinal scale consisting of three or more categories and the measurement scale is level. The advantage of ordinal logistic Regression over logistic Regression is that the dependent variable is multilevel categorical scale data. Moreover, this Regression type can be considered a generalization of either multiple linear Regression or binomial logistic Regression. Like other forms of Regression, ordinal Regression can predict dependent variables through interactions between independent variables. This requires that the dependent variable data scale be ordinal and the independent variable data scale may be categorical or quantitative. Ordinals have different degrees in each category, with better or worse and high or low (Hosmer and Lemeshow, 2000; Akbar et al., 2010).

In this research, we will see how influential a person's interest in playing mobile legends games is on academic achievement, which means that the dependent variable used is categorical data and a multilevel category scale, namely, no influence, influence and very influence. This analytical approach is chosen for its suitability for assessing the relationship between the level of interest in Mobile Legends and the different academic performance levels, categorized as low, moderate, or high GPA. Therefore, this study aims to determine the model of the influence of interest in playing mobile legends games on academic achievement and also to determine what factors significantly influence academic achievement using the ordinal logistic regression method.

## RESEARCH METHODOLOGY

The data used in this research are primary data obtained through online questionnaire surveys. The main objective of this study is to develop a model that can depict the influence of interest in playing Mobile Legends on the academic performance of students enrolled in the Mathematics Program at the Faculty of Mathematics and Natural Sciences, University of Mataram. Additionally, this research aims to identify the factors that significantly impact this relationship.

To achieve these objectives, this research involves several stages of analysis as follows:

### 1. Literature Review

The literature review is the first step in conducting research, to expand references on the subject to be examined, thereby providing a clear foundation and guidance for the study.

### 2. Collecting Temporary Data

Temporary data is collected to test whether the questionnaire created aligns with the researcher's intentions.

### 3. Validity and Reliability Testing

Validity and reliability testing is used to verify whether the questions in the questionnaire distributed are valid and reliable. Validity and reliability testing can be conducted using the following equations (Simamora, 2004):

#### a. Validity testing

$$r_k = \frac{n(\sum xy) - (\sum x \sum y)}{\sqrt{(n \sum x^2 - (\sum x)^2)(n \sum y^2 - (\sum y)^2)}} \quad (1)$$

#### b. Reliability testing

$$r = \left( \frac{k}{k-1} \right) \left( 1 - \frac{\sum \sigma_b^2}{\sigma_t^2} \right) \quad (2)$$

### 4. Collecting Sample Data

The collected data matches the predetermined sample size through a survey using online questionnaires (Hosmer & Lemeshow, 2000).

### 5. Ordinal Logistic Regression

This research will use the ordinal logistic regression method to analyze the available data. The ordinal logistic regression model to be employed is as follows (Hosmer & Lemeshow, 2000):

$$\pi_r(x_i) = \frac{\exp(\beta_{0r} + x_i^T \beta)}{1 + \exp(\beta_{0r} + x_i^T \beta)}; \quad r = 1, 2, \dots, s \quad (3)$$

### 6. Parameter Estimation

Parameter estimation in the ordinal logistic regression model uses the Maximum Likelihood Estimation (MLE) method. The MLE method is commonly used for estimating parameters in the ordinal logistic regression model (Hosmer & Lemeshow, 2000; Gujarati, 2007).

7. Parameter significance testing

Parameter significance testing is conducted collectively using the G-test statistic and individually using the Wald test statistic (Imaslihkah et al., 2013):

a. Simultaneous test

For simultaneous testing, it can be conducted using the following formula:

$$G^2 = -2 \ln \left[ \frac{\left(\frac{n_1}{n}\right)^{n_1} \left(\frac{n_2}{n}\right)^{n_2} \left(\frac{n_3}{n}\right)^{n_3}}{\prod_{i=1}^n [\pi_1(x_i)^{y_{1i}} \pi_2(x_i)^{y_{2i}} \pi_3(x_i)^{y_{3i}}]} \right] \tag{4}$$

b. Partial Test

For partial testing, it can be conducted using the following formula:

$$W = \frac{\hat{\beta}_k}{SE(\hat{\beta}_k)} \tag{5}$$

8. Model Suitability Test

The suitability of the ordinal logistic regression model is evaluated through the coefficient of determination ( $R^2$ ) test. This test aims to measure the extent of the influence of variables on the ordinal logistic regression model. To conduct this test, the following formula can be used (Ghozali, 2018):

$$R^2 = r^2 \times 100 \% \quad ; \quad r^2 = 1 - e^{2(\ln(L_0) - \ln(L_M)) / n} \tag{6}$$

**RESULTS AND DISCUSSION**

**1. Validation and Reliability Testing**

The accuracy of the data used determines the quality of research because data represents the variables under study and serves as evidence in testing hypotheses. A good instrument must meet essential requirements, namely validity and reliability.

a. Validity Test

Validity indicates the extent to which an instrument is valid or reliable. The product-moment correlation formula is used to test the validity level. If the value of  $r_k$  is greater than or equal to the value of  $r_{table}$ , the instrument is considered valid. However, if the value of  $r_k$  is less than the value of  $r_{table}$ , the instrument is considered invalid. The value of  $r_k$  obtained from 34 respondents is presented in the following Table 1.

**Table 1.** Results of the Validity Test

No.	$r_k$	$r_{table}(\frac{\alpha}{2}, n)$	Description
1	0,843	0,338	Valid
2	0,412	0,338	Valid
3	0,553	0,338	Valid
4	0,913	0,338	Valid
5	0,830	0,338	Valid

Based on Table 1, all items or questions are valid, so all items/questions can be used to obtain data.

b. Reliability Test

Reliability refers to the questionnaire's consistency and dependability in measuring something over time. The Cronbach's Alpha formula can be used to test the instrument's reliability. Data is considered reliable if the Cronbach's Alpha value exceeds 0.6. Based on the testing results from 34 respondents, a Cronbach's Alpha value of 0.781 was obtained, indicating that it is greater than 0.6. Therefore, it can be concluded that the questionnaire is reliable and can be used for decision-making in this research.

2. Population and Sample

In this research, the data used is in the form of primary data obtained through a survey. Data is collected through an online questionnaire and supports the research being conducted. The population in this study consists of students in the Mathematics Program at the Faculty of Mathematics and Natural Sciences, University of Mataram. Purposive sampling was chosen as the sampling method to obtain a sample representing the population. The criteria used in this case are students in the Mathematics Program at the Faculty of Mathematics and Natural Sciences, University of Mataram, who are actively enrolled and have a GPA. The proportion used is the number of students who play Mobile Legends. Seventy-nine students play Mobile Legends, and the total number of active students in the Mathematics Program at the Faculty of Mathematics and Natural Sciences, University of Mataram, is 380 students. To determine the sample size for the research, you can use the following formula:

$$n = \frac{\left(Z_{1-\frac{\alpha}{2}}\right)^2 p (1-p)N}{d^2(N-1) + \left(Z_{1-\frac{\alpha}{2}}\right)^2 p (1-p)} = \frac{(1,96)^2 (0,208) (1 - 0,208)(380)}{(0,05)^2(380 - 1) + (1,96)^2 (0,208) (1 - 0,208)}$$

$$= 152,1707 \approx 153$$

Based on the sample size calculation above, the minimum required sample size is 153 samples.

3. Categorization of GPA Data

The GPA variable (Y) was obtained through a questionnaire, with the lowest GPA being 1.89 and the highest GPA being 3.54. Then, steps were taken to categorize the research data, such as calculating the ideal mean and standard deviation, and determining the raw scores for the interval class levels of the research variable. The result is the GPA tendency distribution table as follows:

**Table 2.** Categorization of GPA Distribution

No.	Score	Frequency		Descriptions
		Frequency	%	
1	$X \geq 3,00$	56	35	High GPA
2	$2,45 \leq X < 3,00$	55	34,375	Moderate GPA

3	$X < 2,45$	49	30,625	Low GPA
Total		160	100	

Based on Table 2, the percentage of GPA values for students in the Mathematics Program, out of a total sample of 160 students, shows that 56 students (35%) fall into the high GPA category, 55 students (34.375%) fall into the moderate GPA category, and 49 students (30.625%) fall into the low GPA category.

**4. Categorization of Interest Data**

The interest variable ( $X_1$ ) is measured through a questionnaire consisting of 5 items/questions. From the available questions, the highest score is 12, and the lowest is 5. Subsequently, steps were taken to categorize the research data, such as calculating the ideal mean and standard deviation and determining the raw scores for the interval class levels of the research variable. The result is the interest tendency distribution table as follows:

**Table 3.** Categorization of Interest Distribution

No.	Score	Frequency		Descriptions
		Frequency	%	
1	$X \geq 9,67$	12	7,5	Highly Interested
2	$7,33 \leq X < 9,67$	28	17,5	Interested
3	$X < 7,33$	120	75	Not Interested
Total		160	100	

Based on Table 3, the percentage of interest among students in the Mathematics Program in playing Mobile Legends, out of a total sample of 160 students, shows that 12 students (7.5%) fall into the highly interested category, 28 students (17.5%) fall into the interested category, and 120 students (75%) fall into the not interested category.

**5. Ordinal Logistic Regression**

**a. Parameter Estimation**

The parameter  $\beta$  is estimated by optimizing the likelihood function and obtaining its derivative concerning  $\beta$ . Since the first derivative of the likelihood function is nonlinear, the Newton-Raphson iteration method is used to obtain parameter estimates. After the iteration process, the estimated parameter values are presented in Table 4 below:

**Table 4.** Estimated Parameter Values for Ordinal Logistic Regression

Parameter	Estimation
$\beta_{01}$	-0,641
$\beta_{02}$	0,176
$\beta_{1(1)}$	-0,193

$\beta_{1(2)}$	0,287
$\beta_{1(3)}$	0
$\beta_{2(1)}$	0,092
$\beta_{2(2)}$	0

Therefore, considering the coefficients obtained, the ordinal logistic regression model for the influence of interest in playing Mobile Legends on the academic performance of mathematics students in the Faculty of Mathematics and Natural Sciences is as follows:

$$\begin{aligned} \pi_1(x) &= \frac{\exp(\beta_{01} + \beta_{1(1)}x_{1(1)} + \beta_{1(2)}x_{1(2)} + \beta_{2(1)}x_{2(1)})}{1 + \exp(\beta_{01} + \beta_{1(1)}x_{1(1)} + \beta_{1(2)}x_{1(2)} + \beta_{2(1)}x_{2(1)})} \\ &= \frac{\exp(-0,641 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})}{1 + \exp(-0,641 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})} \\ \pi_2(x) &= \frac{\exp(\beta_{02} + \beta_{1(1)}x_{1(1)} + \beta_{1(2)}x_{1(2)} + \beta_{2(1)}x_{2(1)})}{1 + \exp(\beta_{02} + \beta_{1(1)}x_{1(1)} + \beta_{1(2)}x_{1(2)} + \beta_{2(1)}x_{2(1)})} \\ &= \frac{\exp(0,176 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})}{1 + \exp(0,176 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})} \end{aligned}$$

**b. Parameter Significance Test**

1. Simultaneous Test

Simultaneous parameter significance testing is carried out using the likelihood ratio test. Hypothesis:

$$H_0: \beta_{1(1)} = \beta_{1(2)} = \dots = \beta_{p(r)} = 0$$

$$H_1: \text{there is at least one } \beta_{j(k)} \neq 0, j = 1, 2, \dots, p, k = 1, 2, \dots, r$$

After performing calculations for the simultaneous test statistic, the results are obtained as shown in Table 5 below:

**Table 5. Simultaneous Test Result**

$L_M$	$L_0$	$G^2$
-125,02782	-175,98415	101,91266

Based on Table 5, it can be seen that the value of  $G^2$  is 101,91266, and the critical  $\chi^2_{tabel}$  value is 5,591. The obtained value indicates that  $G > \chi^2_{tabel}$ , so  $H_0$  is rejected, meaning that the independent variables simultaneously affect the dependent variable.

2. Partial Test

Separate parameter significance testing (partial) is performed using the Wald test.

Hypothesis:

$$H_0: \beta_{j(k)} = 0$$

$$H_1: \beta_{j(k)} \neq 0, j = 0,1,2, k = 1,2,3$$

After conducting calculations for the partial test statistic, the results are obtained as shown in Table 6 below:

**Table 6.** Partial Test Value

Parameter	Estimation	SE( $\hat{\beta}_{j(k)}$ )	W	Z <sub>table</sub>	Conclusions
$\beta_{0(1)}$	-0,641	0,023	27,869	2.35	Significant
$\beta_{0(2)}$	0,176	0,023	7,652	2.35	Significant
$\beta_{1(1)}$	-0,193	0,021	9,190	2.35	Significant
$\beta_{1(2)}$	0,287	0,025	11,480	2.35	Significant
$\beta_{2(1)}$	-0,092	0,022	4,182	2.35	Significant

Based on the partial test conducted using the Wald test statistic, the conclusion is that the variables significantly influencing are the "interest" variable with the categories "very interested" and "interested" and the "gender" variable with the category "male". The ordinal logistic regression model for the influence of interest in playing Mobile Legends on the academic performance of mathematics students in the Faculty of Mathematics and Natural Sciences is as follows:

a. Low GPA Model

$$\pi_1(x) = \frac{\exp(-0,641 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})}{1 + \exp(-0,641 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})}$$

b. Moderate GPA Model.

$$\pi_1(x) = \frac{\exp(-0,641 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})}{1 + \exp(-0,641 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})}$$

### 6. Coefficient of Determination for the Model

The result of the  $R^2$  value is 0.471123, which means that the independent variables in the ordinal logistic model can explain 47.1123% of the variation in the dependent variable. In comparison, the remaining 52.8877% is explained by other variables not included in the model. Based on this result, it can be concluded that the obtained model provides good results and is acceptable since all the explanatory variables are statistically significant. The  $R^2$  value is non-negative and corresponds to the square of the multiple correlation coefficient, and the utility of goodness of fit measures depends on whether the analysis focuses on explaining the outcome or explaining the effects of some regressors on the result. This might happen because the independent variables used in the model do not contribute to raising the value of  $R^2$  very much. Therefore, to

obtain a higher value of  $R^2$ , researchers need to put more attention in the choice of variables in the model, be aware of the presence of outliers, and provide more samples (Hagquist and Stenbeck, 1998; Chicco et al., 2021; Chen & Qi 2023; Ozili, 2023).

## CONCLUSION

Taking into careful consideration the results of the data analysis and the methodologies employed, it can be confidently concluded that:

1. The model of the relationship between interest in playing Mobile Legends and the academic performance of students in the Mathematics Program of the Faculty of Mathematics and Natural Sciences, Universitas Mataram, is as follows:

$$\pi_1(x) = \frac{\exp(-0,641 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})}{1 + \exp(-0,641 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})}$$

$$\pi_2(x) = \frac{\exp(0,176 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})}{1 + \exp(0,176 - 0,193x_{1(1)} + 0,287x_{1(2)} - 0,092x_{2(1)})}$$

2. The factors that significantly influence the academic performance of students in the Mathematics Program of the Faculty of Mathematics and Natural Sciences are Interest ( $x_1$ ) with the categories "very interested" and "interested" and Gender ( $x_2$ ) with the category "male."

## REFERENCES

- [1] S.J. Akbar, et al., "Bagging Regresi Logistik Ordinal pada Status Gizi Balita," in *Media Statistika*, vol. 3, no. 2, 2010, pp. 103-116.
- [2] Q. Chen & J. Qi, "How Much Should We Trust  $R^2$  and Adjusted  $R^2$ : Evidence from Regressions in Top Economics Journals and Monte Carlo Simulations," in *Journal of Applied Economics*, vol. 26, no. 1, 2207326, 2023.
- [3] D. Chicco, M.J. Warrens, & G. Jurman, "The Coefficient of Determination  $R$ -squared is More Informative than SMAPE, MAE, MAPE, MSE and RMSE in Regression Analysis Evaluation," in *PeerJ Computer Science*, 7, e623, 2021.
- [4] N. Fitriyani, L. Awalushaumi, & A. Kurnia, "Polytomous Logistic Regression in Analyzing the Presence of National Pilot Mosque in Karang Baru Mataram", in the *Proceeding, 1st ICST* Mataram University, 2016
- [5] I. Ghozali, "Aplikasi Analisis Multivariate dengan Program SPSS 25. Semarang, Universitas Diponegoro, 2018.
- [6] D. Gujarati, *Dasar-dasar Ekonometri Edisi Ketiga, Jilid I dan II*. Erlangga, Jakarta, 2007.
- [7] C. Hagquist & M. Stenbeck, "Goodness of Fit in Regression Analysis- $R^2$  and  $G^2$  Reconsidered", in *Quality and Quantity*, vol. 32, no. 3, pp. 229-245, 1998.
- [8] D.W. Hosmer and S. Lemeshow, "Applied Logistic Regression," John Wiley & Sons, Inc., New York, 2000.
- [9] S. Imaslihkah, et al., "Analisis Regresi Logistik Ordinal Terhadap Predikat Kelulusan Mahasiswa S1 di ITS Surabaya," in *Jurnal Sains dan Seni POMITS*, vol. 2, no. 2, pp. 177-182, 2013.
- [10] F.R. Iskandar, et al., "Dampak Permainan Mobile Legends Terhadap Motivasi Belajar Siswa Sekolah Dasar," in *EduBasic Journal: Jurnal Pendidikan Dasar*, vol. 1, no. 2, pp. 116-122, 2019.

- [11] P.K. Ozili, "The Acceptable R-Square in Empirical Modelling for Social Science Research," in *Social Research Methodology and Publishing Results*, 5 June, 4128165, 2022.
- [12] Playstore, "Games Kategori," 2022. [Online, Accessed 26 July 2022]. Available: <https://play.google.com/store/games>.
- [13] B. Simamora, *Panduan Riset Prilaku Konsumen*. Gramedia, Jakarta, 2004.
- [14] Sugiyono, *Metode Penelitian Kuantitatif*. Bandung, Alfabeta, 2018.
- [15] J. Supratno, *Statistika: Teori dan Aplikasi*. Erlangga, Jakarta, 2000.