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Influence Analysis of the Teacher Ratio and Facilities on Failure to Pass the Class Using Multiple Linear Regression

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Abstract−The quality of education needs to be observed and maintained in building an effective teaching and learning environment. There are several factors that can affect the quality of education in a school, such as the availability of human resources, supportive learning facilities, environmental conditions, and various other factors. The focus of this research is on the ideal number of teachers in a school, considering the number of students and the availability of facilities such as laboratories and libraries, which will be correlated with the failure to pass the class rate. Data were obtained from the official website of the Kemdikbudristek regarding educational statistics, comprising 29 districts in Tangerang Regency for the academic year 2023/2024 at the senior high school level. The analysis was conducted using multiple linear regression, and it was found that the variables "availability of laboratory" and "availability of library" did not correlate with the failure to pass the class rate, whereas the "teacher ratio" variable correlated with the failure to pass the class rate with a value of +0.46. This can be explained that for every increase of 1 unit in the teacher ratio variable, or in other words, the fewer teachers teaching in a school compared to the number of students, the failure to pass the class rate will also increase by 0.46 students. Therefore, the results of this research can provide input for schools, especially in Tangerang Regency, to pay attention to the number of teachers in each school.

Keywords: Facilities; Failure To Pass The Class; School; Multiple Linear Regression; Teacher Ratio

1. INTRODUCTION

Education is one of the crucial aspects in supporting the progress of a nation by producing intelligent generations [1]. Education is acquired by everyone from an early age through parental upbringing, teachers, peers, digital sources, and various other channels [2]. The formative years that significantly influence character development are from childhood to adolescence. Education during this period is primarily sourced from family, school, and social environment [3, 4]. Schools, being where most students spend their daily time, are educational sources that need attention [5].

Graduation from schooling is a proud achievement for all parties involved, including students, parents, teachers, and schools. Conversely, if students failure to pass the class, it can be mentally distressing for both students and parents [6]. Schools also bear the impact as it can tarnish their reputation due to unmet targets for student advancement. This can be detrimental to schools as it reduces the number of new student enrollments, posing a serious challenge for them [7].

The quality of education is the key to addressing these issues. To build a good quality of education in schools, several factors need attention. These factors include insufficient human resources, lack of supportive learning facilities, unfavorable environmental conditions, and various other factors [8]. Teachers play the most crucial role in schools among human resources. They are often referred to as the second parents of children at school because students are constantly educated and guided by their teachers [9]. Teachers not only impart knowledge but also set examples of good behavior and actions for their students. Sometimes it is challenging for teachers to attend to each student individually due to time and energy constraints. Therefore, teacher ratio in schools needs consideration [10].

Availability of facilities is also a critical factor in the teaching-learning process. Facilities include equipment such as whiteboards, LCD projectors, desks, chairs, and various other tools [11]. Additionally, rooms such as classrooms, laboratories, and libraries are essential facilities. However, it is unclear whether the existing facilities are utilized effectively by teachers and students in the teaching-learning process [12].

It cannot be determined whether these factors indeed improve student achievement to prevent students from failure to pass the class. Therefore, a deeper analysis is needed to understand the correlation between various factors and the failure to pass the class rate. This research analyzes the ideal number of teachers in schools relative to the number of students and the availability of facilities such as laboratory and library spaces, to examine the correlation with the number of students who fail to progress, especially in high schools in Tangerang Regency. According to data recorded in the Kemdikbudristek Library, for the academic year 2023/2024, in all high schools

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in Tangerang Regency, there were 71 students who failure to pass the class or had to repeat. This is the highest number compared to other districts in Banten Province.

There have been previous studies conducted by Hirzi on analyzing the factors influencing the dropout rate in West Nusa Tenggara. The research was motivated by the high dropout rate in West Nusa Tenggara Province based on data from the Department of Education and Culture in NTB Satu Data. The Generalized Poisson Regression (GPR) method was used, yielding research results showing significant factors affecting the number of high school dropouts in West Nusa Tenggara Province, including population density, HDI, PMA, and illiteracy rate [13]. This study, along with several previous ones, focused on examining the factors causing student dropouts rather than students failing to advance grades. However, the issue of students failing to advance grades is also an important problem that needs attention as it has the potential to lead to students dropping out. Therefore, this study focuses on identifying factors influencing students failing to advance grades.

Another study conducted by Sholeh regarding the analysis of factors causing student dropouts at MA A1 Mukhlisin in Kampao Village, Blega District, Bangkalan Regency was motivated by the relatively high dropout rate in that area. The research employed multiple linear regression method, revealing that both internal and external factors partially and simultaneously cause student dropouts. However, the results indicate that the t-value for external factors is larger than that for internal factors, implying that external factors, such as economics, parents' education level, parental attention and support, cultural views on education, living environment, and others are more dominant [14]. This study supports the application of multiple linear regression method in identifying the level of correlation or influence of dependent variables with independent variables. It also aims to delve deeper into external factors which are more dominant than internal factors, particularly the variables of teacher ratio and facilities on failure to pass the class.

Considering the background and several previous studies, this study employs multiple linear regression analysis to find the correlation between variables and determine the strength of the correlation among variables. Thus, the results of this research can have significant relevance in efforts to improve the quality of education by examining important factors contributing to reducing the number of students who failure to pass the class, particularly the ideal number of teachers and facility factors.

2. RESEARCH METHODOLOGY

2.1 Research Stages

This research was conducted through several structured research stages, planned from problem identification to reporting, as shown in Figure 1.

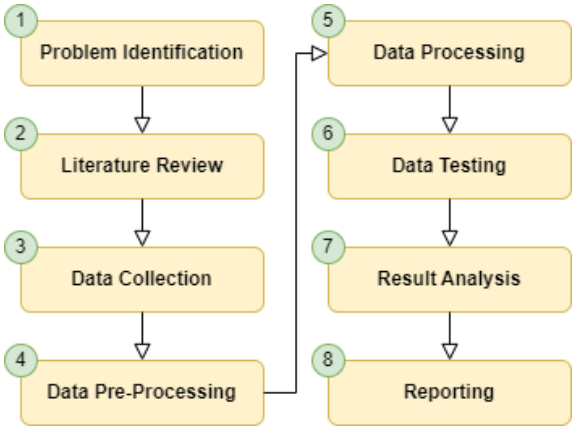

Figure 1. Research Stages

The research process is divided into 8 stages: problem identification, literature review, data collection, data pre-processing, data processing, data testing, result analysis, and reporting. In the initial stage, problem identification is conducted by identifying common issues through reading various sources such as news and articles, as well as conducting a literature review related to theories and research case studies.

The data for this research was obtained from the official website of the Kemdikbudristek regarding educational statistics [15]. The data provided by the Kemdikbudristek on the website includes various data related to research case studies such as district data, number of schools, students, teachers, laboratories, libraries, and the failure to pass the class rate. The data retrieved is from the academic year 2023/2024 in Tangerang Regency, specifically for high schools, which is then stored in an Excel file. Before conducting data processing, the data needs to undergo pre-processing using several Excel functions. This pre-processing stage is essential to transform raw data into semi-processed data that are ready and suitable for the data processing stage using multiple linear regression.

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The data testing stage is necessary to examine the values of each variable obtained from the data processing results. Data testing is performed by conducting t-tests and F-tests, and if the results are not satisfactory, data processing will be repeated using adjusted variables. The final results will be analyzed and conclusions drawn, followed by writing up the research findings through reporting.

2.2 Multiple Linear Regression

Multiple linear regression is one of the statistical methods used to analyze the relationship or association between a dependent variable (response variable) and two or more independent variables (predictor variables) [16]. This method models the linear relationship between these variables, which can generally be done with equation (1):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon \quad (1)$$

where:
Y represents the dependent variable (response variable)
$X_1, X_2, \cdots, X_n$ represent the independent variables (predictor variables)
β_0 is the intercept, which is the value of Y when all X values are zero
$\beta_1, \beta_2, \cdots, \beta_n$ are the regression coefficients that measure the influence of each predictor variable on the response variable
ε represents the random error or disturbance

2.3 F-Test

The F-test, also known as analysis of variance (ANOVA), is a statistical technique used to test significant differences between the means of two or more groups. In the context of regression analysis, the F-test is used to test the overall significance of the regression model, i.e., whether at least one of the predictor variables has a significant influence on the response variable [17]. In the context of linear regression, the F-test compares the variability explained by the regression model to the unexplained variability. In other words, the F-test examines whether the regression model as a whole provides a significant explanation for the variation in the data [18].

The F-test process involves calculating the F-statistic, which is defined as the ratio of the variability explained by the regression model (or the mean squared regression) divided by the variability not explained by the regression model (or the mean squared error) [19]. If the F-statistic is large, it indicates that the regression model as a whole provides a significant explanation for the variation in the data. The hypotheses tested in the F-test are as follows [20]:

H0 : There is no significant difference/relationship from at least one predictor variable to the response variable. It can be said that all regression coefficients are zero, so the regression model lacks the ability to explain variation in the data.

H1 : At least one predictor variable has a significant difference/relationship to the response variable. It can be said that one regression coefficient is not zero, so the regression model has the ability to explain variation in the data.

The F-test results are evaluated using the p-value. If the p-value is less than the specified significance level (usually 0.05), the null hypothesis is rejected, and it is concluded that the regression model as a whole is significant [21]. The F-test is crucial in regression analysis as it provides an understanding of whether the regression model as a whole provides a significant explanation for the response variable.

2.3 t-Test

The t-test is a statistical method used to test the significance of the difference between the means of two independent samples [22]. In the context of regression, the t-test is often used to test the significance of regression coefficients or the difference between the means of coefficients from two different groups. The hypotheses tested in the t-test are as follows [23]:

H0 : There is no difference/relationship between a particular predictor variable and the response variable, so it can be said that a specific regression coefficient is equal to zero.

H1 : There is a relationship between a particular predictor variable and the response variable, so it can be said that a specific regression coefficient is not equal to zero.

The t-test process involves calculating the t-statistic value, which is the comparison between the difference between the sample mean and the population mean (or another sample mean) with the standard error of that difference. If the t-statistic value is sufficiently large, it indicates that the difference between the sample means is statistically significant [24]. In addition to the t-statistic value, we also use the associated p-value to determine whether the observed difference is statistically significant. Generally, if the p-value is less than the specified significance level (e.g., 0.05), we reject the null hypothesis and conclude that the difference is statistically significant [25].

3. RESULT AND DISCUSSION

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A total of 29 data were obtained from the official Kemdikbudristek website and then stored in an Excel file. encapsulating various crucial metrics related to secondary education for the academic year 2023/2024 in Tangerang Regency. The comprehensive dataset is meticulously organized in Table 1, delineating essential information such as district names, school counts, student populations, teacher numbers, laboratory and library availabilities, and the count of students who failed to pass the class.

Table 1. Raw Research Data

No	District	School	Students	Teachers	Laboratory	Library	Failure to Pass the Class
1	Cisoka	6	2,021	106	1	5	6
2	Tiga Raksa	7	3,017	151	3	7	0
3	Cikupa	7	2,647	113	2	6	0
4	Panongan	6	2,056	109	3	6	18
5	Curug	10	3,393	197	1	9	4
6	Legok	4	1,806	83	4	4	0
7	Pagedangan	5	1,655	118	3	5	0
8	Pasar Kemis	12	3,872	201	5	12	3
9	Balaraja	5	3,323	168	4	5	3
10	Kresek	2	1,360	68	1	2	0
11	Kronjo	4	1,241	90	1	2	2
12	Mauk	3	1,750	79	1	3	1
13	Rajeg	13	3,038	170	1	11	10
14	Sepatan	7	3,018	142	1	5	0
15	Pakuhaji	6	2,045	100	1	5	1
16	Teluk Naga	6	3,516	104	4	6	1
17	Kosambi	8	1,932	116	1	6	0
18	Jayanti	9	2,663	174	1	6	5
19	Jambe	3	947	52	0	2	1
20	Cisauk	3	1,355	76	0	3	0
21	Kemiri	3	1,034	50	1	3	0
22	Sukadiri	8	1,520	90	1	7	0
23	Sukamulya	2	1,090	45	0	2	0
24	Kelapa Dua	20	6,758	469	5	19	0
25	Sindang Jaya	5	2,837	127	1	5	1
26	Sepatan Timur	3	1,356	55	2	3	0
27	Solear	3	1,462	79	2	5	0
28	Gunung Kaler	6	990	82	1	7	0
29	Mekar Baru	2	241	26	0	2	8

The process of analyzing the data in Table 1 entails a crucial pre-processing phase, primarily aimed at deriving insights into the optimal teacher ratio and assessing the availability of essential facilities such as laboratories and libraries within each school. An indispensable benchmark in educational settings is the ideal ratio of one teacher per 20 students, serving as a cornerstone for effective teaching and learning dynamics. However, it's imperative to recognize that a teacher's role extends beyond mere instruction; they also play a pivotal role in providing individualized guidance and support to each student. Consequently, as the number of students under a teacher's purview increases, the ability to cater to each student's needs diminishes, highlighting the significance of maintaining manageable class sizes. Conversely, a lower student-to-teacher ratio fosters a conducive environment for personalized attention and support, thereby enhancing overall learning outcomes.

In addition to evaluating the teacher ratio, assessing the availability of key facilities like laboratories and libraries is paramount. Traditionally, schools are equipped with at least one laboratory and one library, serving as vital resources to facilitate various educational activities and augment students' academic capabilities. These facilities not only provide hands-on learning experiences but also foster research skills and promote independent learning among students.

To quantify the teacher-student ratio and the availability of facilities, mathematical formulas are employed. The teacher ratio is computed by dividing the total number of students by the number of teachers for each district, as outlined in formula (2). Similarly, the availability of facilities, encompassing both labs and libraries, is determined by dividing the total number of facilities by the number of schools per district, as depicted in formulas (3) and (4). These calculations yield valuable insights into the distribution of educational resources and the adequacy of teaching personnel across different districts, laying the foundation for informed decision-making and resource allocation in the education sector.

$$\text{Teacher ratio} = \frac{\text{Students}}{\text{Teachers}} \quad (2)$$

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$$\text{Availability of Lab} = \frac{\text{Laboratory}}{\text{School}} \times 100\% \quad (3)$$

$$\text{Availability of Library} = \frac{\text{Library}}{\text{School}} \times 100\% \quad (4)$$

The results of the calculations using these formulas yield pre-processed data as shown in Table 2.

Table 2. Pre-Processed Data

No	District	Teacher Ratio	Availability of Lab	Availability of Library	Failure to Pass the Class
1	Cisoka	19.07	16.67	83.33	6
2	Tiga Raksa	19.98	42.86	100.00	0
3	Cikupa	23.42	28.57	85.71	0
4	Panongan	18.86	50.00	100.00	18
5	Curug	17.22	10.00	90.00	4
6	Legok	21.76	100.00	100.00	0
7	Pagedangan	14.03	60.00	100.00	0
8	Pasar Kemis	19.26	41.67	100.00	3
9	Balaraja	19.78	80.00	100.00	3
10	Kresek	20.00	50.00	100.00	0
11	Kronjo	13.79	25.00	50.00	2
12	Mauk	22.15	33.33	100.00	1
13	Rajeg	17.87	7.69	84.62	10
14	Sepatan	21.25	14.29	71.43	0
15	Pakuhaji	20.45	16.67	83.33	1
16	Teluk Naga	33.81	66.67	100.00	1
17	Kosambi	16.66	12.50	75.00	0
18	Jayanti	15.30	11.11	66.67	5
19	Jambe	18.21	0.00	66.67	1
20	Cisauk	17.83	0.00	100.00	0
21	Kemiri	20.68	33.33	100.00	0
22	Sukadiri	16.89	12.50	87.50	0
23	Sukamulya	24.22	0.00	100.00	0
24	Kelapa Dua	14.41	25.00	95.00	0
25	Sindang Jaya	22.34	20.00	100.00	1
26	Sepatan Timur	24.65	66.67	100.00	0
27	Solear	18.51	66.67	166.67	0
28	Gunung Kaler	12.07	16.67	116.67	0
29	Mekar Baru	9.27	0.00	100.00	8

It can be seen from Table 2 that the majority of teacher ratios obtained ideal values, namely 20 or below. Teluk Naga District has the highest teacher ratio, which is 33.81, indicating that, on average, schools in Teluk Naga District have a relatively high number of students compared to the number of teachers. As for the availability of lab, the values vary, with Legok District achieving the highest value of 100%, while Jambe, Cisauk, Sukamulya, and Mekar Baru Districts have a value of 0%, indicating that schools in those districts do not have labs. Regarding the availability of libraries, each school predominantly receives a value of 100%, with the lowest value found in Kronjo District at 50%.

After going through the data pre-processing stage, the next step is data processing using Excel tools. The results of the data processing using multiple linear regression function yielded the ANOVA table and the Coefficient table, which can be seen in Tables 3 and Table 4.

Table 3. ANOVA Value

	df	SS	MS	F	Significance F
Regression	3	160.52	53.51	2.10	0.13
Residual	25	636.65	25.47		
Total	28	797.17			

Table 4. Coefficient Value

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-3.60	6.29	-0.57	0.57	-16.56	9.37
Teacher Ratio	0.54	0.23	2.36	0.03	0.07	1.00

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	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Availability of Lab	-0.03	0.04	-0.59	0.56	-0.11	0.06
Availability of Library	-0.04	0.05	-0.67	0.51	-0.15	0.07

Data testing was conducted using the F-test and the t-test. To perform the testing, initial hypotheses and alternative hypotheses are required for each test. The following are the initial hypotheses and alternative hypotheses for the F-test:

H0 : The variables teacher ratio, availability of lab, and availability of library do not have a significant joint effect on the variable failure to pass the class.

H1 : The variables teacher ratio, availability of lab, and availability of library have a significant joint effect on the variable failure to pass the class.

Based on the ANOVA values in Table 3, the F-value is found to be 2.10 with a significance value of 0.13. By setting the significance level to 0.05, a comparison of the significance value with the significance level is made, yielding 0.13 < 0.05. This leads to the conclusion that H0 is accepted and H1 is rejected. Next, the t-test is performed with the following initial hypotheses and alternative hypotheses:

H0 : Partially, the variables teacher ratio, availability of lab, or availability of library do not have a significant effect on the variable failure to pass the class.

H1 : Partially, the variables teacher ratio, availability of lab, or availability of library have a significant effect on the variable failure to pass the class.

Based on the coefficient values in Table 4 and using a significance level of 0.05, the comparison of the P-value with the significance level is made. For the variable teacher ratio, the comparison yields 0.03 < 0.05, for the variable availability of lab, the comparison yields 0.56 > 0.05, and for the variable availability of library, the comparison yields 0.51 > 0.05. This leads to the conclusion that for H0, the variable teacher ratio is rejected and H1 is accepted, the variable availability of lab is accepted for H0 and rejected for H1, and the variable availability of library is accepted for H0 and rejected for H1.

From the results of the F-test and the t-test, it is known that the variables teacher ratio, availability of lab, and availability of library do not have a significant joint effect on the variable failure to pass the class. Additionally, partially, neither the availability of lab nor the availability of library have a significant effect on the variable failure to pass the class. Meanwhile, the variable that has a significant effect or correlation with the variable failure to pass the class is the teacher ratio variable.

The next step is to reprocess the data by removing the variables availability of lab and availability of library, as these variables do not have a significant effect on the variable failure to pass the class. The results of the data processing using the multiple linear regression function specifically for the teacher ratio variable yield the Coefficient table, which can be seen in Table 5.

Table 5. Coefficient Value

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-6.37	4.05	-1.57	0.13	-14.67	1.94
Teacher Ratio	0.46	0.21	2.24	0.03	0.04	0.88

Using the previously determined hypotheses and significance level values, a t-test is conducted for the teacher ratio variable. The P-value for the teacher ratio variable is 0.03 < 0.05, so H0 is rejected and H1 is accepted. From the obtained results, a linear relationship between the teacher ratio variable (X_1) and the failure to pass the class variable can be modeled using equation (1), yielding the equation: $Y = -6.37 + 0.46X_1$. This means that the teacher ratio variable has a correlation with the failure to pass the class variable of +0.46.

4. CONCLUSION

Based on the research conducted for multiple linear regression analysis on high school data for the academic year 2023/2024 in Tangerang District, it was found that the ideal number of teachers in schools relative to the number of students correlates with the failure to pass the class rate. However, the availability of facilities such as labs and libraries does not correlate with the failure to pass the class rate. The correlation level between the teacher ratio variable and the failure to pass the class rate is significant at +0.46. This indicates that for every increase of 1 in the teacher ratio variable, or in other words, when there are fewer teachers compared to the number of students in a school, the failure to pass the class rate also increases by 0.46 students. Therefore, it is hoped that high schools, especially in Tangerang District, will pay more attention to the number of teachers in each school, as teachers have a significant impact on the failure to pass the class rate. Implementing an ideal number of teachers in each school can help reduce the failure to pass the class rate. Suggestions for further research include analyzing other factors that may also impact the failure to pass the class rate. Additionally, case studies could be expanded to cover various levels of education, including elementary, junior high, and high schools in different districts and provinces.

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