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THE INFLUENCE OF DIGITAL LITERACY, LEARNING INDEPENDENCE, AND MOTIVATION ON ACADEMIC ACHIEVEMENT IN THE SUBJECT OF BUILDING CONSTRUCTION COST AND SCHEDULING PLANS AMONG GRADE XI DPIB STUDENTS AT SMK NEGERI 3 YOGYAKARTA

Anggie Fadhlia Ash Shaf[1], P Priyanto[2],

[1,2]Yogyakarta State University, Yogyakarta, Indonesia

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ABSTRACT

This study investigates the influence of digital literacy, learning independence, and learning motivation on student achievement in the subject of cost planning and scheduling among Grade XI students of the Building Modeling and Information Design (DPIB) program at SMK Negeri 3 Yogyakarta. Using a quantitative ex post facto design, the study involved 99 students selected from a population of 131 through proportional cluster random sampling. Data on the independent variables were collected using validated questionnaires, while achievement scores were obtained from teacher assessments. The results of multiple regression analysis show that digital literacy, learning independence, and learning motivation each have a significant positive effect on learning achievement, both individually and simultaneously. These findings emphasize the need for vocational education to enhance students' digital skills, promote self-directed learning, and foster motivation. The study offers practical insights for educators and curriculum planners and suggests further research to explore additional psychological or contextual factors affecting learning outcomes.

Corresponding Author:

Anggie Fadhlia Ash Shaf
Yogyakarta State University, Yogyakarta, Indonesia
anggi.ashshaf@gmail.com

1. INTRODUCTION

The advancement of information and communication technology has brought significant changes to the field of education, particularly in how students access, manage, and utilize information. In the midst of rapid digital transformation, digital literacy has emerged as an essential competency, especially for students. It is no longer limited to basic digital skills, but also includes critical thinking, content evaluation, and responsible information creation and sharing. UNESCO defines digital literacy as the ability to access, manage, understand, integrate, evaluate, and create information using digital technology effectively and ethically. Paul Gilster similarly views digital literacy as the ability to critically and reflectively process digital information, while Buckingham emphasizes the technical and cognitive skills necessary for productive digital media use.

In vocational education, particularly in Vocational High Schools (SMK), digital literacy plays a crucial role. The learning model in SMKs emphasizes practical and technical skills, which demand student autonomy and the ability to access field-relevant information. At SMK Negeri 3 Yogyakarta, especially within the Building Information Modeling and Design (DPIB) program, the subject of Construction Cost Estimation and Scheduling requires students to independently process complex technical information using digital tools. Although

technological facilities are provided, preliminary observations show that students' use of digital resources remains suboptimal, affecting their learning motivation, independence, and ultimately their academic performance.

Previous studies suggest that digital literacy, learning motivation, and independence are individually linked to academic success. Wahyuni (2021) highlights that low digital literacy correlates with decreased motivation and difficulty in self-directed learning. Ayu (2019) confirms that learning motivation significantly contributes to student achievement in tech-integrated environments. Anhusada (2020) adds that students with strong digital literacy are more likely to exhibit high levels of learning independence. However, few studies have explored the interaction between these three variables—digital literacy, learning independence, and motivation—especially in the context of technical vocational subjects such as construction cost planning.

Therefore, this study aims to specifically analyze the influence and interrelationship between digital literacy, learning independence, and motivation on the academic achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta. The focus on the Construction Cost Estimation and Scheduling subject is based on its inherently technical and information-intensive nature, which demands both digital competence and autonomous learning. By exploring how these variables interact and which has the strongest influence, this study seeks to address a significant gap in the literature on vocational education in Indonesia.

This research is urgent and relevant, considering Indonesia's current educational challenges in adapting vocational learning to the digital age. Insights from this study are expected to contribute to the development of effective, digital-based instructional strategies that enhance student autonomy, motivation, and academic achievement. Moreover, the findings can inform curriculum planning and educational policies to strengthen digital learning in SMKs.

This study is limited to evaluating students' digital literacy, learning independence, and motivation in relation to their academic performance in a single subject. Nonetheless, the focused scope allows for a deeper understanding of key factors influencing success in vocational education. The results are expected to provide practical recommendations for educators and administrators in designing targeted interventions to improve learning outcomes in the era of digital education.

2. RESEARCH METHODS

This study employed a quantitative ex post facto design, selected to examine relationships among variables that could not be manipulated by the researcher. This design is appropriate in educational settings, where variables such as digital literacy, learning motivation, and academic achievement naturally occur. Unlike experimental designs, ex post facto studies allow for investigation of existing conditions without intervention, although they do not establish direct causality. Given the contextual constraints of vocational education, this method offers a realistic approach while maintaining scientific rigor.

The study aimed to determine the influence of digital literacy, learning independence, and learning motivation on students' academic achievement in the subject of Construction Cost Estimation and Scheduling. Conducted in May 2023 at SMK Negeri 3 Yogyakarta, the research focused on Grade XI students enrolled in the Building Information Modeling and Design (DPIB) program.

The population consisted of 131 students. A sample of 99 students was selected using proportional cluster random sampling, ensuring representativeness by proportionally drawing from existing class clusters within the program. The sample size was determined using the Slovin formula with a 5% margin of error.

Data collection involved two primary instruments: (1) a questionnaire to measure the independent variables (digital literacy, learning independence, and motivation), and (2) documentation to obtain final exam (UAS) scores representing academic achievement. The questionnaire was developed based on established theoretical indicators and used a five-point Likert scale. Instrument validity and reliability were assessed through a pilot test involving 30 students, with most items showing strong reliability (Cronbach's Alpha > 0.7) and content validity reviewed by experts.

Data were analyzed using descriptive statistics to summarize variable characteristics (mean, standard deviation, min-max) and inferential statistics to test hypotheses. Before regression analysis, data were tested for normality using the Kolmogorov-Smirnov test, and for linearity to confirm suitability for linear regression. Additionally, assumptions of multicollinearity, autocorrelation, and heteroscedasticity were examined to ensure model robustness.

Multiple linear regression analysis was used to assess both simultaneous and partial effects of the independent variables on academic achievement. Variables included Digital Literacy (X_1), Learning Independence (X_2), and Learning Motivation (X_3), with Academic Achievement (Y) as the dependent variable. Analysis was performed using statistical software to ensure accuracy.

While this method is appropriate, it is important to note its limitations. The ex post facto design does not allow for causal inference, and unmeasured confounding variables may influence outcomes. These limitations were addressed through careful sampling and instrument validation, but should be considered when interpreting the findings. Despite this, the study offers meaningful insights into the correlational dynamics of digital-era learning in vocational education.

3. RESULT AND ANALYSIS

Research Results

Descriptive statistics is a branch of statistics used to collect, present, and interpret data with the aim of providing an overview of the distribution of research data. By using descriptive statistics, researchers can understand and summarize data systematically, gain better insights, and draw informative conclusions based on objective data analysis.

This study was conducted among 11th-grade students of the DPIB program at SMK Negeri 3 Yogyakarta, which consists of four classes: 11 DPIB 1, 11 DPIB 2, 11 DPIB 3, and 11 TKPr. The objective of this research is to determine the influence of Digital Literacy, Learning Independence, and Learning Motivation on the academic achievement of students in the subject of Construction Cost Estimation and Scheduling. The sample was selected using a proportional cluster random sampling approach, resulting in a total of 131 samples, distributed as follows:

Table 1. Research Sample Distribution

No	Class	Number of Samples
1	11 DPIB 1	34
2	11 DPIB 2	32
3	11 DPIB 3	33
4	11 TKPr	32

The descriptive statistical analysis for each research variable is presented as follows:

Digital Literacy Variable (X1)

The Digital Literacy variable was analyzed based on the tabulated results of the questionnaire distributed to research respondents. Data processing using statistical software revealed that the highest score for the Digital Literacy variable was 93 and the lowest was 62. The mean score was 76.12, the median was 77, and the mode was 79. The standard deviation (SD) was calculated at 12. Furthermore, the frequency distribution was calculated using Sturges' formula, resulting in the following frequency table, which further illustrates the spread and characteristics of the Digital Literacy variable:

Table 2. Frequency Distribution of Digital Literacy Variable (X1)

No	Interval Class	F
1.	62 – 65	2
2.	66 - 69	9
3.	70 – 73	24
4.	74 – 77	19
5.	78 – 81	31
6.	82 – 85	11
7.	86 – 89	2
8.	90 - 93	1

Source: Processed Primary Data

The data were then categorized into levels of Digital Literacy using ideal mean (Mi) and ideal standard deviation (SDi) values to determine variability levels. Further information on the classification of Digital Literacy based on these categories is shown in the table below:

Table 3. Frequency Distribution by Digital Literacy Category

No	Norm	Score Range	Category	F	%
1.	$X > (Mi + SDi)$	$X > 66$	Very Good	97	98%
2.	$Mi \leq X \leq (Mi + SDi)$	$54 \leq X \leq 65$	Good	2	2%
3.	$(Mi - SDi) \leq X < Mi$	$42 \leq X \leq 54$	Fair	0	0%
4.	$X < Mi - SDi$	$X < 42$	Poor	0	0%
		Total		99	100%

Source: Djemari Mardapi (2008: 123)

This table shows the frequency distribution across four categories for the Digital Literacy variable. It can be observed that the "Very Good" category has the highest frequency at 97 (98%), followed by the "Good" category

with a frequency of 2 (2%), while the "Fair" and "Poor" categories each recorded a frequency of 0 (0%). The frequency distribution results for Digital Literacy were further visualized using a pie chart. The pie chart illustrates the tendency of the Digital Literacy variable based on the frequency distribution table. In this diagram, the proportion of each Digital Literacy category is displayed as a percentage relative to the total sample, providing a clear visual representation of the variable's distribution.

Learning Independence Variable (X2)

The Learning Independence variable was analyzed through the tabulated results of questionnaires distributed to the study respondents. Data processing using statistical software revealed that the highest score for the Learning Independence variable was 46, while the lowest score was 19. The mean score was recorded at 35.24, with a median value of 36. The mode, or the most frequently occurring score, was also 36. The standard deviation (SD) for the Learning Independence variable was calculated at 6. Furthermore, the frequency distribution was determined using Sturges' formula, resulting in the following frequency table. This table provides further insight into the spread and characteristics of the Learning Independence variable:

Table 4. Frequency Distribution of Learning Independence Variable (X2)

No	Interval Class	F
1.	19 - 22	1
2.	23 – 26	0
3.	27 – 30	10
4.	31 - 34	27
5.	35 - 38	46
6.	39 - 42	11
7.	43 - 46	4

Source: Processed Primary Data

The data were then categorized into levels of Learning Independence, based on their variability using the ideal mean (Mi) and ideal standard deviation (SDi). Further information regarding the classification of Learning Independence according to these variable categories is presented in the following table:

Table 5. Frequency Distribution by Learning Independence Category

No	Norm	Score Range	Category	F	%
1.	X > (Mi + SDi)	X > 33	Very Good	79	80%
2.	Mi ≤ X ≤ (Mi + SDi)	27 ≤ X ≤ 32	Good	19	19%
3.	(Mi – SDi) ≤ X < Mi	21 ≤ X ≤ 27	Fair	0	0%
4.	X < Mi – SDi	X < 21	Poor	1	1%
Total				99	100%

Source: Djemari Mardapi (2008: 123)

This table represents the frequency distribution across four categories related to a single variable. It can be seen that the "Very Good" category has the highest frequency at 79 (80%), while the category with the lowest frequency is "Poor" with only 1 respondent (1%). The "Good" category followed with 19 respondents (19%), and the "Fair" category had no respondents (0%). The frequency distribution results for the Learning Independence category were then visualized using a pie chart. This pie chart illustrates the tendency of the Learning Independence variable based on the frequency distribution table. In this diagram, the proportion of each category within the Learning Independence variable is displayed as a percentage relative to the total sample, providing a clear visual representation of the distribution of the Learning Independence variable.

Learning Motivation Variable (X3)

The Learning Motivation variable was analyzed through the tabulation of questionnaires distributed to the study respondents. Data processing using statistical software revealed that the highest score for the Learning Motivation variable was 75, while the lowest score was 48. The mean score of the Learning Motivation variable was recorded at 60.08, with a median value of 60. The mode, or most frequently occurring score, was also 60. The standard deviation (SD) for the Learning Motivation variable was calculated to be 10. Furthermore, the frequency distribution was determined using Sturges' formula, resulting in the following frequency table. This table provides further insight into the distribution and characteristics of the Learning Motivation variable studied:

Table 6. Frequency Distribution of the Learning Motivation Variable (X3)

No	Interval Class	F
1.	48 – 51	3
2.	52 – 55	13
3.	56 – 59	25
4.	60 – 63	36
5.	64 – 67	14

6.	68 - 71	6
7.	72 - 75	2

Source: Processed Primary Data

The data were then categorized into levels of Learning Motivation based on their variability, using the ideal mean (Mi) and ideal standard deviation (SDi). Further details regarding the classification of Learning Motivation into variable categories are presented in the following table:

Table 7. Frequency Distribution by Learning Motivation Category (X3)

No	Norm	Score Range	Category	F	%
1.	X > (Mi + SDi)	X > 55	Very Good	86	87%
2.	Mi ≤ X ≤ (Mi + SDi)	45 ≤ X ≤ 54	Good	13	13%
3.	(Mi – SDi) ≤ X < Mi	35 ≤ X ≤ 45	Fair	0	0%
4.	X < Mi – SDi	X < 35	Poor	0	0%
		Total		99	100%

Source: Djemari Mardapi (2008: 123)

This table represents the frequency distribution across four categories related to a single variable. It can be observed that the "Very Good" category recorded the highest frequency at 86 (87%), while the category with the lowest frequency was "Good" with 13 respondents (13%). The "Fair" and "Poor" categories had equal frequencies of 0 (0%). The frequency distribution results for the Learning Motivation category were subsequently illustrated using a pie chart. The pie chart is employed to visualize the tendencies of the Learning Motivation variable based on the frequency distribution table. In this diagram, the proportion of each category within the Learning Motivation variable is displayed as a percentage relative to the total sample. This provides a clear visual representation of the distribution of the Learning Motivation variable.

Learning Achievement Variable (Y)

The Learning Achievement variable was analyzed through the tabulation of students' academic performance scores obtained from the final semester grades. Data processing using statistical software revealed that the highest score for the Learning Achievement variable was 97, while the lowest score was 76. The mean score for the Learning Achievement variable was recorded at 81.17, with a median value of 80. The mode, or the most frequently occurring score, was 77. The standard deviation (SD) of the Learning Achievement variable was calculated to be 4.15. When presented in the form of a Grading Norm, the learning achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta is shown in the following table:

Table 8. Grading Norm of the Learning Achievement Variable (Y)

No	KKM	Category	Frequency	Percentage
1.	≥ 75	Passed	97	98%
2.	< 75	Not Passed	2	2%
	Total		99	100%

Source: Processed Primary Data

Based on the Grading Norm presented in the table, the learning achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta can be illustrated in the form of a histogram as follows:

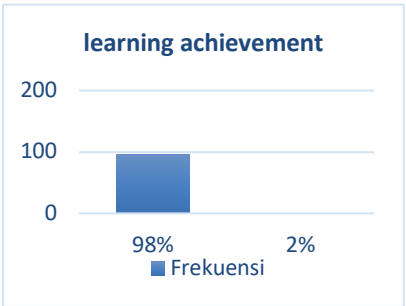

Figure 1. Histogram of Frequency Distribution for Learning Achievement Categories (Y)

Based on the table and histogram above, it is shown that the Learning Achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta falls within the "Passed" category at 98% (97 students), and the "Not Passed" category at 2% (2 students).

Prerequisite Test Analysis

Prerequisite Test Analysis, also known as Classical Assumption Testing, is conducted to determine whether a multiple linear regression model encounters any issues related to classical assumptions. The classical assumption issues in this study were analyzed in three stages: the normality test, the linearity test, and the multicollinearity test. The results of the prerequisite data analysis can be summarized as follows:

1. **NORMALITY TEST**

The normality test is a statistical method used to assess the conformity of data to a normal distribution. The significance of the normality test lies in the fact that many statistical analyses assume that the data are normally distributed. In this study, the normality assumption test was conducted using the Kolmogorov-Smirnov method, which requires the data to be considered normally distributed if the significance value (Asymp. Sig. (2-tailed)) is greater than 0.05. The results of the normality assumption test are presented in the following table:

Table 9. Normality Test Results

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		99
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	3.81552633
Most Extreme Differences	Absolute	.087
	Positive	.087
	Negative	-.078
Test Statistic		.087
Asymp. Sig. (2-tailed)		.061[c]
a. Test distribution is Normal.		

The normality test table displays the results of the normality test for several variables, including Digital Literacy (X1), Learning Independence (X2), Learning Motivation (X3), and Learning Achievement (Y). The test statistic refers to the value used in the normality test, while Asymp. Sig. (2-tailed) represents the p-value indicating the test's significance. Based on the p-values shown in the Asymp. Sig. (2-tailed) column, all variables have values greater than the 0.05 significance level. This indicates that there is insufficient evidence to reject the null hypothesis that the data for these variables are normally distributed. Therefore, based on the normality test results, it can be concluded that the variables Digital Literacy, Learning Independence, Learning Motivation, and Student Learning Achievement satisfy the normality assumption. This suggests that the data distribution for these variables tends to be symmetric around the mean value.

2. LINEARITY TEST

The linearity test is a statistical method used to evaluate the linear relationship between two variables. The purpose of this test is to determine whether the relationship between the variables can be adequately explained using a linear model, such as a straight line. In the linearity test, methods such as regression analysis are employed to examine whether a pattern of relationship can be approximated by a linear trend. The data are considered to have a linear distribution if the value for Deviation from Linearity is greater than the alpha level of 0.05. The results of the linearity test for this research model are presented in the following table:

Table 10. Linearity Test Results

RELATIONSHIP	F	SIG	DESCRIPTION
X1 TO Y	1,189	0,284	LINEAR
X2 TO Y	0,920	0,554	LINEAR
X3 TOY	0,495	0,961	LINEAR

The table shows the results of the linearity test between several variables: Digital Literacy (X1), Learning Independence (X2), and Learning Motivation (X3), in relation to Learning Achievement (Y). The F column indicates the linearity test statistic, while the Sig column shows the p-values, all of which are greater than the 0.05 significance level. This implies that there is insufficient evidence to reject the null hypothesis that there is a linear relationship between these independent variables and the dependent variable Y. Accordingly, it can be concluded from the linearity test that Digital Literacy (X1), Learning Independence (X2), and Learning Motivation (X3) meet the assumption of linearity in relation to the Learning Achievement variable (Y). This means that the relationships between these variables and Learning Achievement (Y) can be approximated using a linear model, such as a straight line. However, it should be noted that although a significant linear relationship is indicated, the linearity test does not provide information about the strength or specific form of the linear relationship among the variables.

3. MULTICOLLINEARITY TEST

The multicollinearity test is a statistical method used to evaluate the presence of multicollinearity issues in regression analysis. Multicollinearity occurs when there is a strong correlation between two or more independent variables within the regression model. This condition can lead to problems in interpreting the regression results and may hinder the ability to obtain stable and accurate estimations.

The purpose of conducting a multicollinearity test is to ensure the reliability of the regression analysis results and to provide a more accurate interpretation. The multicollinearity test can be carried out using various methods, such as the Variance Inflation Factor (VIF), which measures the extent to which the variance of one variable can be explained by other variables in the model. A research model is considered free from multicollinearity issues when all the independent variables have VIF values less than 10. The results of the multicollinearity test are presented in the following table:

Table 11. Results of the Multicollinearity Test

VARIABLE	COLLINIERITY STATISTIC		DESCRIPTION
	TOLLERENCE	VIF	
LITERASI DIGITAL (X1)	0,758	1,320	MULTICOLLINEARITY DOES NOT OCCUR
KEMANDIRIAN BELAJAR (X2)	0,590	1,695	MULTICOLLINEARITY DOES NOT OCCUR
MOTIVASI BELAJAR (X3)	0,600	1,666	MULTICOLLINEARITY DOES NOT OCCUR

Based on the VIF values listed in the VIF column, all variables show VIF scores below 10. These low VIF values indicate that there is no significant multicollinearity problem within the model. The higher the VIF value, the stronger the correlation between the independent variables in the model.

Therefore, based on the results of the multicollinearity test, it can be concluded that there is no significant multicollinearity issue among the variables Digital Literacy (X1), Learning Independence (X2), and Learning Motivation (X3). This suggests that these variables can be used together in the regression analysis without encountering significant multicollinearity problems.

4. Multiple Linear Regression Analysis

The multiple linear regression model is a linear regression model that involves more than one independent variable (X). When more than one independent variable is used to estimate the value of Y, the first-degree equation is referred to as a regression surface. The calculation of regression coefficient values is performed by solving a system of equations. The model used to estimate these effects can be seen in the following table:

Table 12. Results of Multiple Linear Regression Analysis

Coefficients[a]				
Model		Unstandardized Coefficients		Standardized Coefficients
		B	Std. Error	Beta
1	(Constant)	94.123	2.527	
	Digital Literacy	0.213	0.063	0.112
	Learning Independence	0.408	0.050	0.270
	Learning Motivation	-0.598	0.016	-0.980

Based on the computer output analysis using statistical software, as shown in Table 12, the multiple linear regression equation is obtained as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e$$

$$Y = 94.123 + 0.213 X_1 + 0.408 X_2 + -0.598 X_3 + e$$

From the regression equation above, the following research findings can be interpreted:

Based on the equation, the constant value is 94.123. This indicates that if all independent variables are assumed to remain constant, the value of the dependent variable (Academic Achievement) increases by 94.123 units.

a. The coefficient of Digital Literacy (X_1) is 0.213, which means that if Digital Literacy increases by 1 unit, Academic Achievement will also increase by 0.213 units, assuming other variables are held constant.
b. The coefficient of Learning Independence (X_2) is 0.408, indicating that if Learning Independence increases by 1 unit, Academic Achievement will increase by 0.408 units, assuming other variables remain constant.
c. The coefficient of Learning Motivation (X_3) is -0.598, meaning that if Learning Motivation increases by 1 unit, Academic Achievement will decrease by 0.598 units, assuming other independent variables are

constant. The negative coefficient indicates a negative relationship between Learning Motivation and Academic Achievement; the higher the motivation, the lower the academic achievement in this context.

5. Hypothesis Testing

The hypothesis testing employed in this study refers to a statement or temporary assumption that remains weak or unproven and therefore requires validation. Hypothesis testing is a method used to assess a claim or hypothesis regarding a population parameter by utilizing data measured from a sample. Through hypothesis testing, researchers are able to respond to specific research questions by determining whether to accept or reject the proposed hypotheses. The absolute truth of a hypothesis can never be fully known unless observations are made across the entire population. In this study, the hypothesis testing comprises both the t-test and F-test.

a. PARTIAL HYPOTHESIS TESTING (T-TEST)

The t-test is used to determine the extent to which Digital Literacy, Learning Independence, and Learning Motivation individually influence Academic Achievement. The purpose of the t-test is to evaluate the significance level of each independent variable on the dependent variable. If the calculated t-value (tcount) exceeds the critical t-value (ttable), the alternative hypothesis (Ha) is accepted and the null hypothesis (H0) is rejected, and vice versa. The results of the t-test can be seen in Table 13 below:

Table 13. Results of the t-Test

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	sig
		B	Std. Error	Beta		
1	(Constant)	94.123	2,527		37,244	0,000
	Digital Literacy	0,213	0,063	0,112	3,380	0,001
	Learning Independence	0,408	0,050	0,270	8,145	0,000
	Learning Motivation	-0,598	0,016	-0,980	-36,463	0,000

a. Dependent Variable: Academic Achievement

Table 13 presents the results of the data analysis on the variables Digital Literacy, Learning Independence, and Learning Motivation in relation to Academic Achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta. Based on the results of the t-test analysis, the calculated t-values (t_{count}) for the variables are as follows: Digital Literacy (X1) is 3.380, Learning Independence (X2) is 0.408, and Learning Motivation (X3) is -0.598. The critical t-value (t_{table}) in this study was determined using a significance level of $\alpha = 0.05$, with a sample size (n) of 99 and the number of independent variables (k) equal to 3, so the t_{table} value can be determined as follows:

$$t_{tabel} = t(\frac{\alpha}{2}; n - k - 1)$$
$$t_{tabel} = t(0{,}025; 99 - 3 - 1)$$
$$t_{tabel} = t(0{,}025; 95)$$
$$t_{tabel} = 1{,}984$$

Based on the calculated t-values (t_{count}) and the critical t-value (t_{table}) mentioned earlier, it can be concluded that the data analysis for the Digital Literacy variable (X1) shows that t_{count} > t_{table}, or 3.380 > 1.984. This means that, partially, there is a significant effect of Digital Literacy (X1) on the Academic Achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta. The analysis of the Learning Independence variable (X2) also shows that t_{count} > t_{table}, or 8.145 > 1.984. This indicates that Learning Independence (X2) partially has a significant effect on students' Academic Achievement. Furthermore, the analysis result for the Learning Motivation variable (X3) shows that the t_{count} value is -36.463, which was evaluated using a Degree of Freedom (df) of 95. This implies a significant influence, although the negative t-value suggests the relationship may be inversely correlated.

Table 14. Results of Anova

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5157.387	3	1719.129	453.091	.000[b]
	Residual	360.451	95	3.794		

Total	5517.838	98			
Regression	5157.387	3	1719.129	453.091	.000[b]

a. Dependent Variable: Academic Achievement (*Prestasi Belajar*)

b. Predictor Variables: (Constant), Digital Literacy (*Literasi Digital*), Learning Independence (*Kemandirian Belajar*), Learning Motivation (*Motivasi Belajar*)

Based on the degree of freedom (df) = 95, the one-tailed critical t-value (t_{table}) is 1.661. The calculated t-value (t_{count}) for the Learning Motivation variable is -36.463. By disregarding the negative sign, it can be concluded that t_{count} > t_{table}, or 36.463 > 1.661. In other words, there is a significant influence of the Learning Motivation variable (X3) on the Academic Achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta.

b. SIMULTANEOUS TEST (F-TEST)

The F-test is used to determine the extent to which all independent variables collectively influence the dependent variable. If the calculated F-value (F_{count}) is greater than the critical F-value (F_{table}), then the alternative hypothesis (Ha) is accepted and the null hypothesis (Ho) is rejected, and vice versa. In this study, the F-test is used to analyze the simultaneous effect of Digital Literacy, Learning Independence, and Learning Motivation on the Academic Achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta. The results of the F-test analysis are presented as follows:

Table 15. Results of Anova

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5157.387	3	1719.129	453.091	.000[b]
	Residual	360.451	95	3.794		
	Total	5517.838	98			

a. Dependent Variable: Academic Achievement.

b. Predictor Variables: (Constant), Digital Literacy, Learning Independence, Learning Motivation.

The results of the F-test analysis, which indicate that the calculated F-value (F_{count}) is 453.091 and the critical F-value (F_{table}) is 2.70. This demonstrates that F_{count} > F_{table}, or 453.091 > 2.70. These results confirm that the variables Digital Literacy, Learning Independence, and Learning Motivation simultaneously have a significant effect on the Academic Achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta. The F_{table} value of 2.70 was determined based on the sample size (n) of 99 and the number of independent variables (k) equal to 3. More specifically, it is defined as follows:

$$F_{tabel} = F(k; n - k)$$
$$F_{tabel} = F(3; 99 - 3)$$
$$F_{tabel} = F(3; 96)$$
$$F_{tabel} = 2{,}70$$

c. DETERMINATION COEFFICIENT TEST (R^2)

The coefficient of determination test (R-squared or R^2) is used to measure the extent to which the model is capable of explaining the variation in the dependent variable. The value of the coefficient of determination ranges from zero to one. Through the analysis of the determination coefficient test, the predictive power of the model in explaining the Academic Achievement variable can be assessed. The coefficient of determination is presented in Table 14 as follows:

Table 15. Coefficient of Determination (R^2)

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0,967[a]	0,935	0,933	1,948

a. Predictors: (Constant), Digital Literacy, Learning Independence, Learning Motivation

Based on the SPSS output in the "Model Summary" table above, the coefficient of determination (R Square) is 0.935. This R Square value of 0.935 is derived from the square of the correlation coefficient (R), namely 0.967 × 0.967 = 0.9350. The value of the coefficient of determination (R Square) is 0.935 or equal to 93.4%. This means that the variables Digital Literacy (X1), Learning Independence (X2), and Learning Motivation (X3) collectively contribute 93.4% to the Academic Achievement of Grade XI DPIB students at SMK Negeri 3

Yogyakarta. The remaining 6.6% (100% - 93.4%) is influenced by other variables outside the regression equation or variables not examined in this study.

d. CORRELATION ANALYSIS BY VARIABLE

The correlation test used is Pearson's correlation. This type of correlation is a simple correlation that involves only one dependent variable and one independent variable. Pearson's correlation produces a correlation coefficient that measures the strength of the linear relationship between two variables. If the relationship between the two variables is not linear, the Pearson correlation coefficient may not accurately reflect the strength of their association, even if a strong relationship exists. The results of the Pearson correlation analysis for the variables Digital Literacy (X1), Learning Independence (X2), and Learning Motivation (X3) with Academic Achievement (Y) are presented in Table 15 below:

Table 15. Pearson Correlation Analysis Results by Variable

Correlations

		Digital Literacy	Learning Independence	Learning Motivation	Academic Achiever
Digital Literacy	**Pearson Correlation**	**1**	**.139**	**.140**	**-.900****
	Sig. (2-tailed)		**.170**	**.168**	**.000**
	N	**99**	**99**	**99**	**99**
Learning Independence	**Pearson Correlation**	**.139**	**1**	**.381****	**.101**
	Sig. (2-tailed)	**.170**		**.000**	**.321**
	N	**99**	**99**	**99**	**99**
Learning Motivation	**Pearson Correlation**	**.140**	**.381****	**1**	**.119**
	Sig. (2-tailed)	**.168**	**.000**		**.239**
	N	**99**	**99**	**99**	**99**
Academic Achievement	**Pearson Correlation**	**-.900****	**.101**	**.119**	**1**
	Sig. (2-tailed)	**.000**	**.321**	**.239**	
	N	**99**	**99**	**99**	**99**

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

Table 15 presents the results of the Pearson correlation analysis for each independent variable (X) with the dependent variable (Y). The results show that Digital Literacy (X1) has a very strong negative correlation with Academic Achievement (Y), with a coefficient of -0.900. This indicates a perfect negative relationship, meaning that as Digital Literacy increases, Academic Achievement tends to decrease. Meanwhile, Learning Independence (X2) and Learning Motivation (X3) show very weak positive correlations with Academic Achievement (Y), with coefficients of 0.101 and 0.119, respectively. Although weak, these relationships are positive, indicating that higher levels of Learning Independence and Learning Motivation are associated with higher levels of Academic Achievement among Grade XI DPIB students at SMK Negeri 3 Yogyakarta.

Discussion

This study consists of three independent variables and one dependent variable. The independent variables include Digital Literacy, Learning Independence, and Learning Motivation, while the dependent variable is the Academic Achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta. The discussion in this research links the findings with previous studies to identify both similarities and differences. Based on the results obtained, the following is a detailed discussion of each research finding:

The Influence of Digital Literacy on the Academic Achievement of Grade XI DPIB Students at SMK Negeri 3 Yogyakarta

The research results showed that the t-statistic value (t_{count}) was greater than the critical t-value (t_{table}), specifically 3.380 > 1.984. Furthermore, the significance test produced a p-value of 0.001 < 0.05, indicating that Digital Literacy significantly influences students' academic achievement. The positive coefficient value demonstrates a positive influence of Digital Literacy on Academic Achievement. Thus, it can be concluded that Digital Literacy has a positive and significant effect on student achievement, confirming the acceptance of the first hypothesis (H_1).

Digital literacy is defined as the ability and skill required to access, analyze, create, reflect on, and act using various digital tools, forms of expression, and communication strategies (Anggeraini et al., 2019). In today's digital era, digital literacy is essential for everyone, especially for students at all levels of education—from primary to tertiary education (Amri et al., 2021, p. 546). For learners, being digitally literate equips them with critical thinking skills to assess the credibility of information, as well as the ability to contextualize, analyze, and synthesize any

information found online. In essence, digital literacy is a necessary skill for all individuals in the 21st century. It enables better access to accurate information and improves the overall quality of education (Fatmawati, 2019, pp. 119–138).

In this context, the use of digital literacy offers students the opportunity to actively engage in the learning process, which ultimately enhances their academic outcomes. In an educational institution, the success of learning processes is measured by students' academic achievement, and one contributing factor to low academic performance is a lack of literacy (Nadila et al., 2022, p. 197). Digital literacy is just as important as reading, writing, arithmetic, and other disciplines, and in practice, it often has more meaningful applications (Sulianta, 2020, p. 4). It represents students' awareness and capability to operate digital tools, making it a key 21st-century competence (Wulandari et al., 2022, p. 357). Promoting digital literacy enables students to construct their own knowledge using e-books and interactive digital learning media provided by educators. The emergence of the digital era has brought significant changes in education, from transforming teaching practices to encouraging innovative and creative learning styles that rely heavily on digital media, thereby positively influencing the development of students' and teachers' skills (Sari et al., 2020, p. 47).

Previous studies have also demonstrated the positive effect of digital literacy, student engagement, and learning independence on academic achievement. Arima et al. (2021, p. 107) concluded that digital literacy influences elementary students' learning outcomes. Nisa and Fitrayati (2022, p. 82) found that digital literacy had a significant effect, while learning independence did not significantly influence the learning outcomes of senior high school students in economics. Similarly, Arryadna and Pratiwi (2022, p. 5786) reported that digital literacy partially and significantly affects vocational high school students' learning outcomes. Soeprijanto et al. (2022, p. 172) concluded that the direct effect of digital literacy on university students' learning achievement was stronger than its indirect effect through career planning. The ongoing research by Widowati et al. (2024, p. 1597) further supports this, showing a positive influence of digital literacy on students' mathematics learning achievement.

The Influence of Learning Independence on the Academic Achievement of Grade XI DPIB Students at SMK Negeri 3 Yogyakarta

The research results showed that the t-statistic value (t_{count}) was greater than the critical t-value (t_{table}), specifically 8.145 > 1.984. Additionally, the significance test produced a p-value of 0.000 < 0.05, indicating that Learning Independence has a significant influence on the Academic Achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta. The positive coefficient value indicates a positive effect, meaning that better learning independence contributes positively to improved academic achievement. Therefore, it can be concluded that Learning Independence has a positive and significant effect on students' academic achievement.

These findings align with those of Kurniawan (2022, p. 33), who concluded that learning independence positively influences academic achievement. Learning independence is an essential attribute for students, as it enables them to control their own behavior, regulate their learning processes, and evaluate their learning progress in order to achieve optimal academic outcomes.

In a study conducted by Bernadeta (2023, p. 3796), academic achievement is described as a measurement and assessment of learning outcomes conducted by teachers after students engage in the learning process. These outcomes are validated through testing and expressed in the form of symbols—such as numbers, letters, or descriptive narratives—that reflect students' learning accomplishments. In formal education, academic achievement serves as a key indicator of student capability. Recognizing differences in students' academic performance helps teachers assess students' understanding of lesson content during the teaching and learning process.

Academic performance is influenced by multiple factors, both internal and external. External factors include family background, school environment, infrastructure, teachers, curriculum, teaching methods, and living environment. Internal factors, on the other hand, come from within the student, such as physical health, motivation, intelligence, independence, and attitude. Academic achievement is often used to evaluate how well a student has mastered the content taught in class, and is typically reflected in changes in knowledge and skills (Wulandari et al., 2022, p. 350).

Academic achievement can also be seen as the result of learning efforts; the more diligent a student is, the more likely they are to achieve satisfying academic results. Learning independence is crucial in the educational process, as students with high levels of independence are better equipped to handle challenges related to learning materials, which ultimately leads to improved academic achievement (Asipi, 2022, p. 9920).

The Influence of Learning Motivation on the Academic Achievement of Grade XI DPIB Students at SMK Negeri 3 Yogyakarta

The research findings indicate that the t-statistic (t_{count}) is -36.468, which is lower than the critical value (t_{table}) of 1.984. Additionally, the significance level is 0.000 < 0.05, implying that Learning Motivation has a significant effect on students' Academic Achievement. However, the negative coefficient suggests a negative relationship, meaning that an increase in learning motivation corresponds with a

decrease in academic achievement among the students. This counterintuitive result is likely influenced by the students' low self-confidence during classroom learning activities. Many students lacked confidence during lessons, as reflected in behaviors such as reluctance to engage in discussions (e.g., asking questions, expressing opinions, responding to peers or teachers), classroom disruptions, frequent gadget use, disengagement from lessons, failure to complete assignments, and inattentiveness to the teacher's explanations. This finding is consistent with research by Fitranty Adirestuty (2019, pp. 158–165), which revealed a negative effect of learning motivation on academic achievement, and with the study by Zulfikar et al. (2021, pp. 63–72), which also concluded that learning motivation has a negative and significant effect on students' academic performance at SMA Muhammadiyah Maumere.

The Simultaneous Influence of Digital Literacy, Learning Independence, and Learning Motivation on the Academic Achievement of Grade XI DPIB Students at SMK Negeri 3 Yogyakarta

The results of the study show that the variables of Digital Literacy, Learning Independence, and Learning Motivation simultaneously have a significant effect on the Academic Achievement of Grade XI DPIB students. The analysis demonstrated that the F-statistic (F_{count}) of 453.091 is greater than the critical F-value (F_{table}) of 2.70, with a significance level of 0.000 < 0.05. This confirms that the combined influence of Digital Literacy, Learning Independence, and Learning Motivation significantly impacts students' academic performance. In general, the findings suggest that positive improvements in digital literacy and learning independence are associated with increased academic achievement in the subject "Construction Budget Planning" (Rencana Anggaran Biaya), and vice versa. Several internal factors, such as self-confidence, sense of responsibility, strong belief, and the desire for self-improvement, contribute to the effective application of digital literacy and learning independence in enhancing student achievement.

These findings are in line with the study by Dyah Nur Khasanah (2023), which concluded that Digital Literacy and Learning Independence have a positive and significant effect on learning achievement in Basic Accounting. Digital literacy is defined as the ability to access diverse information from various sources using digital technology and the internet. In the context of remote learning, it plays a vital role across all educational levels (Zahroh & Sholeh, 2022, pp. 1147–1158). The ease of accessing information via digital platforms broadens students' knowledge base, supporting their learning needs efficiently and flexibly—anytime and anywhere (Sumiati & Wijonarko, 2020, pp. 65–80).

4. CONCLUSION

Based on the research findings, this study concludes that digital literacy, learning independence, and learning motivation significantly influence the academic achievement of Grade XI DPIB students at SMK Negeri 3 Yogyakarta. Specifically, digital literacy was found to have a significant negative effect on academic achievement, as indicated by a t-value of 3.380 and a strong negative correlation coefficient of -0.90. This suggests that although students may be digitally literate, excessive or unfocused use of digital tools could detract from their learning outcomes. In contrast, learning independence demonstrated a significant positive influence, with a t-value of 8.145 and a positive correlation of 0.101, reinforcing the importance of fostering self-regulated learning in vocational education. Interestingly, learning motivation showed a significant but negative effect on academic achievement, with a t-value of -36.468. This counterintuitive result may be due to the type or quality of motivation—such as externally driven goals or overexertion—leading to stress or reduced performance.

When analyzed simultaneously, all three variables—digital literacy, learning independence, and learning motivation—had a statistically significant effect on student achievement, as indicated by an F-value of 453.091. These results highlight the need for more balanced and reflective use of digital tools in learning, greater emphasis on cultivating autonomous learning habits, and better understanding of motivational factors. Practically, this suggests that schools should implement targeted strategies such as digital literacy training focused on purposeful use, learning models that promote independence, and motivational approaches that align with achievable academic goals.

This study, however, is not without limitations. The research was confined to a single vocational school, one academic subject, and a cross-sectional design, which limits the generalizability of the findings and prevents causal interpretation. Additionally, unmeasured external factors may have influenced the outcomes. Future research is encouraged to explore these variables using experimental or longitudinal approaches across diverse vocational school contexts. Moreover, examining potential moderating factors—such as socio-economic status, school infrastructure, or the nature of students' digital engagement—could provide a deeper understanding of these relationships.

Finally, the findings must be viewed within the local context of SMK Negeri 3 Yogyakarta, where technical curriculum demands and access to technology present unique challenges and opportunities. While the results are valuable for informing curriculum development and pedagogical strategies at similar institutions, further validation across broader settings is necessary to ensure their wider applicability in the Indonesian vocational education landscape.

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