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Analyzing the Influence of Academic Competence and Soft Skills on Vocational Students' Work Readiness Using Regression and Machine Learning Approaches

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Abstract

This study examines the influence of academic competence and soft skills on vocational high school students' work readiness by integrating multiple linear regression and machine learning classification approaches. A quantitative method was applied using data collected from 90 final-year students. Statistical analyses included descriptive statistics, classical assumption testing, and multiple linear regression. Additionally, machine learning models Decision Tree, Naive Bayes, and Support Vector Machine (SVM) were employed to classify students' work readiness levels. The dataset was divided into training (70%) and testing (30%) subsets, and model performance was evaluated using accuracy, precision, recall, and F1-score. The results show that academic competence ($p = 0.000$) and soft skills ($p = 0.006$) significantly influence work readiness, with $R^2 = 0.348$. The SVM model achieved the highest accuracy (85.56%). These findings demonstrate that integrating statistical and machine learning approaches provides both explanatory and predictive insights.

Keywords: academic competence, soft skills, work readiness, machine learning.

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INTRODUCTION

The increasingly competitive nature of the labor market in the era of globalization and digitalization demands human resources who possess not only strong academic competencies but also adequate soft skills. This transformation has a direct impact on the education system, particularly Vocational High Schools (Sekolah Menengah Kejuruan/SMK), which play a strategic role in preparing graduates who are ready to enter the workforce (Rifai et al., 2025; Sitanggang et al., 2022). SMKs are designed to produce skilled labor that is prepared for industrial demands; however, in reality, many SMK graduates are not fully absorbed into the labor market. This indicates a gap between students' competencies and industry requirements (Taufan et al., 2025; Yousef, 2024).

Academic competence is one of the key factors underlying students' ability to understand knowledge and technical skills relevant to their field of expertise. It includes theoretical mastery, analytical abilities, and technical skills acquired during the learning process (Ramos-Monge et al., 2023; Yousef, 2024). However, in practice, academic competence alone is not sufficient to ensure students' work readiness. The modern workplace places significant emphasis on non-technical abilities or soft skills, such as communication, teamwork, leadership, adaptability, and work ethics (Septiani Kamal et al., 2025).

Soft skills often become the main differentiating factor between job-ready graduates and those who are not. Many companies report that although SMK graduates may possess adequate technical abilities, they often lack communication skills, discipline, responsibility, and teamwork capabilities (Harianto et al., 2025; Sinaga et al., 2024). This condition indicates that the development of soft skills in educational institutions is still not optimal. In fact, a balance between academic competence and soft skills is essential to meet the demands of the ever-evolving labor market (Nurjanah et al., 2022a).

In addition, the advancement of information technology and data science has opened new opportunities for analyzing factors influencing students' work readiness. One approach that can be used is the application of classification algorithms in machine learning. Classification algorithms are capable of grouping data based on specific characteristics and predicting certain outcomes, in this case, students' work readiness. By using this method, researchers can identify patterns of relationships between academic competence, soft skills, and levels of work readiness in a more objective and data-driven manner (Butar-butar & Wijaya, 2025; Nurhaini, 2024).

The use of classification algorithms in educational research is still relatively new; however, it has great potential to provide deeper insights. Various algorithms such as Decision Tree, Naive Bayes, and Support Vector Machine can be used to classify students based on their level of work readiness (Azizah et al., 2021; Chaurasia et al., 2025). The results of this classification are beneficial not only for researchers but also for schools in designing more effective learning strategies that align with industry needs (Nurjanah et al., 2022b; Suyatmo et al., 2024).

On the other hand, the importance of SMK students' work readiness is closely related to government efforts to reduce unemployment rates, particularly open unemployment among vocational school graduates (Inderanata & Sukardi, 2023; Patricia Aprilita et al., 2024). The high unemployment rate among SMK graduates indicates that there are still issues within the education and training system that need to be addressed. Therefore, a comprehensive analysis is required to identify the factors that most significantly influence students' work readiness (Patricia Aprilita et al., 2024; Suyatmo et al., 2024).

However, most previous studies rely solely on statistical approaches such as regression analysis, which are limited to explaining relationships without predictive capability. Therefore, there is a need to integrate machine learning techniques to enhance predictive analysis.

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This study fills the gap by combining regression analysis with classification algorithms (Decision Tree, Naive Bayes, and SVM), providing both explanatory and predictive insights into students' work readiness.

METHOD

This study employs a quantitative research approach to analyze the influence of academic competence and soft skills on vocational high school students' work readiness using classification algorithms. The quantitative method is appropriate for examining relationships between variables objectively through statistical procedures (Sugiyono, 2019).

The population of this study consists of vocational high school (SMK) students. The sample size is determined using the Slovin formula, which is widely used to estimate sample size when the population is known and the researcher sets a margin of error (Sevilla et al., 2007). The formula is as follows:

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

Where:
n = sample size
N = population size
e = margin of error

Assuming the population (N) is 116 students and the margin of error (e) is 5% (0.05), the calculation is:

$$n = \frac{116}{1 + 116(0.05)^2} \quad (2)$$

$$n = \frac{116}{1 + 116(0.0025)} \quad (3)$$

$$n = \frac{116}{1 + 0.29} \quad (4)$$

$$n = \frac{116}{1.29} = 89.92 \approx 90 \quad (5)$$

Thus, the sample size used in this study is 90 respondents. The sampling technique applied is purposive sampling, where respondents are selected based on specific criteria, namely final-year students who are considered ready to enter the workforce (Sugiyono, 2019).

The data used in this research are primary data collected through a structured questionnaire using a Likert scale. According to Likert scale theory, attitudes and perceptions can be measured through scaled responses (Sekaran & Bougie, 2016). The variables measured include academic competence (X1), soft skills (X2), and work readiness (Y). Academic competence covers mastery of theoretical knowledge and technical skills, while soft skills include communication, teamwork, adaptability, discipline, and responsibility. Work readiness is measured through indicators such as confidence, preparedness, and ability to meet workplace demands.

Data analysis is conducted through several stages. First, descriptive statistics are used to describe respondent characteristics. Second, classical assumption tests—normality, multicollinearity, and heteroscedasticity—are conducted to ensure the validity of the regression model (Ghozali, 2018). Third, multiple linear regression analysis is used to examine the effect of independent variables on the

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dependent variable. Hypothesis testing is carried out using the t-test (partial) and F-test (simultaneous), along with the coefficient of determination (R^2).

In addition, classification algorithms such as Decision Tree, Naive Bayes, and Support Vector Machine (SVM) are applied to classify students' work readiness levels. According to Han, Kamber, and Pei (2012), classification techniques in data mining are useful for predicting categorical outcomes and identifying patterns within data. Data processing is carried out using SPSS and supporting machine learning tools.

In addition, machine learning classification was applied. The dataset was divided into training (70%) and testing (30%) sets. The algorithms used include Decision Tree, Naive Bayes, and Support Vector Machine (SVM). Model performance was evaluated using accuracy, precision, recall, and F1-score.

RESULTS AND DISCUSSION

RESULTS

Descriptive Statistical Analysis

Table 1. Descriptive Statistical Analysis

Statistics

		Age	Sex	Class/Level
N	Valid	90	90	90
	Missing	0	0	0
Mean		2.46	1.78	2.13
Median		2.00	2.00	2.00
Mode		2	2	2
Std. Deviation		.950	.418	.722
Minimum		1	1	1
Maximum		4	2	3
Sum		221	160	192

Table 1 presents the descriptive statistics of the respondents' demographic characteristics, namely age (Usia), gender (Jenis Kelamin), and class/grade level (Kelas/Tingkat). The total number of valid observations is 90 for all variables, indicating that there are no missing data, which strengthens the reliability of the dataset. The mean value for age is 2.46, suggesting that the majority of respondents fall within the mid-range category of the age classification used in this study. The median and mode values for age are both 2, indicating that the most common age group is concentrated around this category. The standard deviation of 0.950 reflects a moderate dispersion, meaning that respondents' ages are relatively varied but still clustered.

For gender, the mean value of 1.78 indicates that one category (likely female, depending on coding) is more dominant. The median and mode are both 2, reinforcing this dominance. The low standard deviation (0.418) suggests that gender distribution is less varied compared to age. Meanwhile, for class/grade level, the mean value is 2.13, with both median and mode equal to 2, indicating that most respondents are in the middle grade level. The standard deviation of 0.722 shows moderate variability.

Overall, this table provides an initial overview of the sample characteristics, which is essential for understanding the context of the study. These demographic distributions help ensure that subsequent analyses, particularly those examining the influence of academic competence and soft skills on work readiness, are based on a representative and well-distributed sample

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Classical Assumption Test

1. Normality Test

Table 2. Normality Test

One-Sample Kolmogorov-Smirnov Test

			Unstandardized Residual
N			90
Normal Parameters[a,b]	Mean		.0000000
	Std. Deviation		5.18676873
Most Extreme Differences	Absolute		.190
	Positive		.111
	Negative		-.190
Test Statistic			.190
Asymp. Sig. (2-tailed)[c]			.125
Monte Carlo Sig. (2-tailed)[d]	Sig.		.127
	99% Confidence Interval	Lower Bound	.122
		Upper Bound	.131

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.
d. Lilliefors' method based on 10000 Monte Carlo samples with starting seed 2000000.

Table 2 shows the results of the normality test using the One-Sample Kolmogorov-Smirnov test on the regression residuals. Normality is a key assumption in regression analysis, as it ensures that the residuals are normally distributed, which allows for valid statistical inference. Based on the table, the number of observations used in the test is 90, and the mean of the residuals is 0.000, indicating that the residuals are centered around zero as expected in a well-fitted regression model.

The test statistic value is 0.190, and the Asymptotic Significance (2-tailed) is 0.125. Since this significance value is greater than the standard alpha level of 0.05, it can be concluded that the residuals are normally distributed. This conclusion is further supported by the Monte Carlo significance value of 0.127, which also exceeds 0.05. Additionally, the confidence interval for the Monte Carlo significance (0.122 to 0.131) remains above the threshold, reinforcing the robustness of the result.

The presence of normally distributed residuals indicates that the regression model meets one of the classical assumptions required for reliable estimation. This strengthens the validity of subsequent analyses, including hypothesis testing and interpretation of regression coefficients. In the context of this study, it means that the relationship between academic competence, soft skills, and work readiness can be analyzed without concern for bias caused by non-normal data distribution.

2. Multicollinearity Test

Table 3. Multicollinearity Test

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	Academic Competence (X1)	.778	1.285
	Soft Skills (X2)	.778	1.285

a. Dependent Variable: Work Readiness (Y)

Table 3 presents the results of the multicollinearity test, which examines whether there is a high correlation between independent variables—in this case, academic competence (X1) and soft skills (X2). Multicollinearity can distort regression estimates and reduce the reliability of conclusions if present at high levels. The test uses two key indicators: Tolerance and Variance Inflation Factor (VIF).

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The tolerance value for both variables is 0.778, which is well above the minimum acceptable threshold of 0.10. This indicates that a large proportion of the variance in each independent variable is not explained by the other variable. Meanwhile, the VIF value for both variables is 1.285, which is significantly below the critical value of 10. This suggests that there is no serious multicollinearity problem in the model.

These results imply that academic competence and soft skills are sufficiently independent of each other, allowing each variable to contribute uniquely to explaining work readiness. This is particularly important in this study, as both variables are conceptually distinct but may still be related in practice. The absence of multicollinearity ensures that the regression coefficients are stable and interpretable.

Thus, the model satisfies the multicollinearity assumption, enabling further analysis to proceed with confidence. It also supports the idea that both academic competence and soft skills can be simultaneously included in the model to assess their individual and combined effects on vocational high school students' work readiness.

3. Heteroscedasticity test

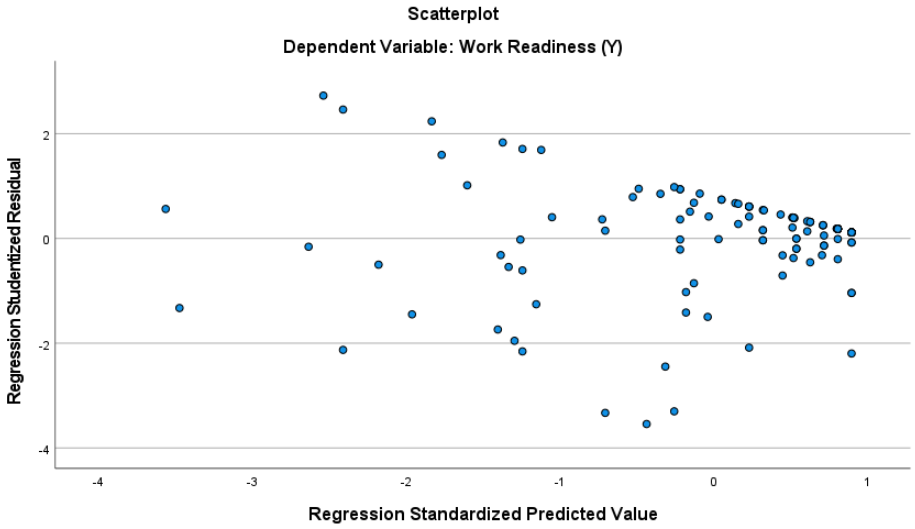


Figure 1. Results of heteroscedasticity test with scatterplot

The results of the heteroscedasticity test using a scatterplot show that the points are randomly distributed above and below zero without any particular pattern. This indicates that there is no heteroscedasticity, thus confirming that the regression model in this study is suitable for further analysis.

Multiple Linear Regression Test

Table 4. Result of Multiple Linear Regression Test

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	9.478	2.504		3.785	.000
	Soft Skills	.295	.105	.292	2.814	.006
	Academic Competence	.360	.099	.376	3.628	.000
a. Dependent Variable: Work Readiness						

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Based on the results of the multiple linear regression test presented in the table above, the regression equation can be used to explain the relationship between the independent variables, namely Academic Competence (X1) and Soft Skills (X2), and the dependent variable, Work Readiness (Y) of vocational high school students. Referring to the regression output, the model can be formulated as follows:

$$WR = 9.478 + (0.295)\ (\text{Soft Skills}) + (0.360)\ (\text{Academic Competence}) + \varepsilon$$

The regression equation indicates that both independent variables have a positive influence on work readiness. The constant value of 9.478 shows the baseline level of work readiness when both academic competence and soft skills are assumed to be zero. Although this condition is theoretical, it serves as a starting point for interpreting the model. The coefficient of Soft Skills (0.295) implies that for every one-unit increase in students' soft skills, their work readiness will increase by 0.295 units, assuming that academic competence remains constant. This suggests that interpersonal abilities, communication, teamwork, and adaptability contribute positively to preparing students for the workforce. Meanwhile, the coefficient of Academic Competence (0.360) indicates that a one-unit increase in academic competence will lead to a 0.360 increase in work readiness, holding soft skills constant. This shows that academic competence has a stronger influence compared to soft skills, highlighting the importance of technical knowledge and mastery of vocational subjects.

Overall, the regression equation demonstrates that both academic competence and soft skills have a positive and meaningful contribution to students' work readiness. The magnitude of each coefficient reflects how much change occurs in work readiness when there is a change in each independent variable, assuming other variables remain constant.

Hypothesis Testing

1. T-Test (Partial)

Table 5 shows the results of the t-test, which evaluates the partial effect of each independent variable on the dependent variable. The purpose of this test is to determine whether academic competence and soft skills individually have a significant influence on work readiness.

The results indicate that soft skills (Soft Skills) have a t-value of 2.814 with a significance level of 0.006. Since this value is less than 0.05, it can be concluded that soft skills have a statistically significant effect on work readiness. Similarly, academic competence (Academic Competence) has a t-value of 3.628 with a significance level of 0.000, indicating an even stronger and highly significant effect. Comparing the standardized coefficients (Beta), academic competence (0.376) has a larger impact than soft skills (0.292). This suggests that while both variables are important, academic competence plays a more dominant role in determining students' readiness for work.

Table 5. Results of the T-test (Partial)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	9.478	2.504		3.785	.000
	Soft Skills	.295	.105	.292	2.814	.006
	Academic Competence	.360	.099	.376	3.628	.000

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a. Dependent Variable: Work Readiness

These results confirm the study's hypothesis that both academic competence and soft skills significantly influence vocational high school students' work readiness. The findings highlight the importance of balancing technical knowledge with interpersonal and behavioral skills in preparing students for the workforce.

2. F-Test (imultaneous)

Table 6. F test results (Simultaneous)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1262.876	2	631.438	23.181	.000[b]
	Residual	2369.846	87	27.240		
	Total	3632.722	89			

a. Dependent Variable: Work Readiness

b. Predictors: (Constant), Academic Competence, Soft Skills

Table 6 presents the results of the F-test, which evaluates the simultaneous effect of all independent variables on the dependent variable. This test determines whether academic competence and soft skills together significantly influence work readiness.

The F-value obtained is 23.181, with a significance level of 0.000. Since the significance value is less than 0.05, it can be concluded that the regression model is statistically significant. This means that academic competence and soft skills, when considered together, have a significant combined effect on work readiness.

The regression sum of squares (1262.876) indicates the variation explained by the model, while the residual sum of squares (2369.846) represents unexplained variation. The relatively large regression sum of squares suggests that the model has a meaningful explanatory power.

This result supports the overall research hypothesis that both academic competence and soft skills are important predictors of work readiness. It also reinforces the idea that these variables should not be considered in isolation, as their combined effect provides a more comprehensive understanding of students' preparedness for entering the workforce.

R2 Test (Coefficient of Determination)

Table 7. R2 Test Results

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.590[a]	.348	.333	5.219

a. Predictors: (Constant), Academic Competence, Soft Skills

Table 7 shows the coefficient of determination (R^2), which measures how well the independent variables explain the variation in the dependent variable. The R value is 0.590, indicating a moderate positive relationship between the independent variables and work readiness.

The R Square value is 0.348, meaning that 34.8% of the variation in work readiness can be explained by academic competence and soft skills. The adjusted R Square is 0.333, which accounts for the number of variables in the model and provides a more accurate estimate. This suggests that approximately one-third of the variability in work readiness is explained by the model.

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The remaining 65.2% is influenced by other factors not included in the study, such as work experience, motivation, family background, or external training. The standard error of the estimate (5.219) indicates the average deviation of observed values from the regression line.

Overall, this result shows that while academic competence and soft skills are important predictors, they are not the only factors influencing work readiness. This opens opportunities for further research to explore additional variables and improve the predictive power of the model.

Machine Learning Classification Results

Table 8. Classification Model Performance

Model	Accuracy	Precision	Recall	F1-score
SVM	85.56%	0.85	0.86	0.85
Decision Tree	82.22%	0.81	0.82	0.81
Naive Bayes	78.89%	0.78	0.79	0.78

The results indicate that the SVM model achieved the highest accuracy (85.56%), outperforming Decision Tree and Naive Bayes. This finding suggests that the relationship between variables is non-linear and better captured by SVM. Furthermore, machine learning models, particularly SVM, can complement statistical analysis by providing predictive insights, thereby strengthening the robustness of the findings.

DISCUSSION

1. The Influence of Soft Skills on Work Readiness

The results of the partial t-test indicate that soft skills have a significant effect on vocational high school students' work readiness, as evidenced by a t-value of 2.814 and a significance level of 0.006 ($p < 0.05$). This finding confirms that soft skills play an important role in preparing students to enter the workforce. The positive regression coefficient (0.295) further indicates that an increase in soft skills will lead to an increase in work readiness.

This result is consistent with the theory proposed by Robbins and Judge (2017), who argue that soft skills—such as communication, teamwork, adaptability, and emotional intelligence—are essential competencies required in the workplace. These skills enable individuals to interact effectively with colleagues, adapt to organizational changes, and solve problems collaboratively. In addition, Goleman (2006) emphasizes that emotional intelligence, as part of soft skills, significantly contributes to professional success, often exceeding the importance of technical abilities in certain contexts.

In the context of vocational education, soft skills are particularly crucial because students are expected not only to master technical competencies but also to demonstrate professional attitudes and behaviors. The findings of this study support the notion that students who possess strong interpersonal and behavioral skills are better prepared to meet workplace demands. Employers increasingly prioritize these competencies as they influence productivity, teamwork, and organizational culture.

Therefore, the significant influence of soft skills on work readiness suggests that vocational high schools should integrate soft skills development into their curriculum. Training programs, collaborative projects, and experiential learning can be effective strategies to enhance these competencies.

2. The Influence of Academic Competence on Work Readiness

The t-test results also show that academic competence has a significant and stronger influence on work readiness, with a t-value of 3.628 and a significance level of 0.000 ($p < 0.05$). The regression coefficient of 0.360 indicates that academic competence contributes positively to students' readiness for

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work, and its standardized beta value (0.376) suggests that it has a more dominant effect compared to soft skills.

This finding aligns with the theory of Bloom (1956), which emphasizes that cognitive abilities and knowledge mastery are fundamental in shaping individuals' performance. Academic competence reflects students' understanding of theoretical concepts and technical skills relevant to their field of study. In vocational education, this competence is directly linked to students' ability to perform specific job tasks effectively.

Furthermore, Spencer and Spencer (1993) highlight that competence includes knowledge and skills that are critical for superior job performance. Academic competence, therefore, forms the foundation upon which practical and professional skills are built. Without sufficient academic preparation, students may struggle to meet industry standards and adapt to job requirements.

The results of this study indicate that vocational students with higher academic competence are more prepared to enter the workforce. This is because they possess the necessary technical knowledge and problem-solving abilities required in their respective fields. Consequently, educational institutions must ensure that curriculum delivery is aligned with industry needs and emphasizes both theoretical understanding and practical application.

Thus, the significant influence of academic competence reinforces its importance as a key determinant of work readiness in vocational education.

3. The Simultaneous Influence of Academic Competence and Soft Skills on Work Readiness

The results of the F-test show that academic competence and soft skills simultaneously have a significant effect on work readiness, as indicated by an F-value of 23.181 and a significance level of 0.000 ($p < 0.05$). This demonstrates that the regression model is statistically significant and that both variables collectively contribute to explaining students' work readiness.

This finding is supported by the theory of employability proposed by Yorke (2006), which states that work readiness is influenced by a combination of knowledge, skills, and personal attributes. Academic competence represents the knowledge and technical skills, while soft skills reflect personal attributes and interpersonal abilities. The integration of these elements creates a comprehensive profile of employability.

Additionally, Jackson (2014) argues that employers seek graduates who possess both hard skills and soft skills, as the combination enhances job performance and adaptability. The results of this study confirm that these two variables should not be viewed independently but rather as complementary factors that jointly determine work readiness.

The coefficient of determination ($R^2 = 0.348$) indicates that 34.8% of the variation in work readiness can be explained by academic competence and soft skills. While this suggests a moderate level of explanatory power, it also implies that other factors, such as work experience, motivation, and environmental influences, contribute to the remaining variation.

Overall, the simultaneous significance of these variables highlights the importance of a balanced educational approach. Vocational high schools should design learning systems that integrate academic learning with soft skills development to better prepare students for the demands of the labor market.

CONCLUSIONS

This study concludes that academic competence and soft skills have a positive and significant influence on vocational high school students' work readiness. Academic competence shows a more dominant effect, indicating the importance of technical knowledge and mastery of vocational skills, while soft skills contribute to adaptability, communication, and teamwork abilities required in the workplace.

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In addition, the integration of machine learning provides an important contribution by enabling the classification and prediction of students' work readiness. Among the tested models, the Support Vector Machine (SVM) demonstrated the best performance, indicating that work readiness patterns are complex and non-linear. This finding highlights the importance of combining statistical and data-driven approaches to enhance analytical accuracy.

Practically, the results of this study can assist educational institutions in identifying students with low levels of work readiness and designing targeted interventions. From a policy perspective, vocational education should integrate academic competence, soft skills development, and data-driven evaluation methods to better prepare graduates for the labor market.

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