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Analysis of Job Suitability with Automotive Engineering Educational Background of Vocational High School Graduates

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Abstract: Many Automotive Engineering vocational school graduates end up working outside their field due to pressing economic needs. They tend to choose available jobs rather than wait for jobs that match their skills. Their families' limited financial situation means they don't have the flexibility to wait for job openings in the automotive industry, especially if those jobs require additional skills they haven't yet mastered. This situation reflects the fact that economic factors are the primary driver of career decisions, even when those decisions are not aligned with one's educational background. To address this issue, various strategies can be implemented. One such strategy is strengthening relationships between schools and industry through link and match programs. This study aims to determine the extent to which automotive engineering competence and the type of job pursued influence the job relevance of vocational high school (SMK) automotive graduates. A quantitative approach was employed using a survey method, and the data were analyzed through simple and multiple regression analysis. The sample consisted of SMK Automotive Engineering graduates in Gunungsitoli who had entered the workforce in 2023–2024. The results showed a significant relationship between automotive engineering competence and the type of job pursued with the job relevance of graduates. Both independent variables made a substantial contribution to the alignment between job and educational background.

Keywords: Automotive engineering competence; Job relevance; Job type; Vocational education; Vocational school graduates

Introduction

Vocational education, particularly Automotive Engineering in vocational high schools (SMK), is crucial for preparing a skilled workforce. However, there is a gap between Automotive Engineering graduates and the needs of the workforce. Many graduates are unemployed or unemployed due to a lack of school-industry connections, outdated curricula, and limited real-world work experience (Mainga et al., 2022; Mseleku, 2022). This phenomenon is reinforced by 2023 BPS data, which shows a higher unemployment rate among vocational high school graduates than high school graduates. Furthermore, many students choose this major not because of interest, but because of limited options or parental influence, which impacts their motivation to learn and job readiness. The theory-focused curriculum and limited practical facilities further exacerbate this problem, compounded by economic factors that push graduates to seek employment outside their field (Mseleku, 2022).

Many Automotive Engineering vocational high school graduates do not work in the automotive sector (Wahyudi et al., 2021; Suyitno et al., 2022), but instead shift to other sectors such as trade and services, or even experience prolonged unemployment (Kurniawan et al., 2021; Ariansyah et al., 2024). This phenomenon indicates a mismatch between their educational background and

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the jobs they pursue (Wardani et al., 2021; Sevilla et al., 2021). Several studies indicate that the main causes of this mismatch are a lack of connection between schools and industry, an outdated curriculum, and a lack of real-world work experience provided during education (Bouw et al., 2019; Nurmik & Timoštšuk, 2024). Therefore, the vocational high school curriculum is designed to prepare students to immediately enter the workforce (Inderanata & Sukardi, 2023; Seo & Lee, 2024). This is reinforced by the issuance of Minister of Industry Regulation Number 3 of 2017 concerning Guidelines for the Development and Development of Competency-Based Vocational High Schools that Link and Match with Industry. Link and match refers to the connection and match of graduate competencies from the educational world to ensure acceptance and suitability with the needs of the workforce (Cavanagh et al., 2015; García-Álvarez et al., 2022).

The link and match strategy between schools and industry needs to be strengthened through in-depth collaboration, project-based internship programs, and comprehensive career guidance (Gumay et al., 2024; Zamiri & Esmaeili, 2024). The integration of digital technology into learning, such as simulation and automotive software, is also crucial (Haleem et al., 2022; Lu & Xie, 2024). Finally, the development of soft skills such as communication, problem-solving, and teamwork must be an integral part of the curriculum (Orih et al., 2024; Mohammed & Ozdamli, 2024). With these steps, it is hoped that graduates of Automotive Engineering Vocational Schools will be better prepared and competitive in the workforce. Based on the above background, this research was conducted with the aim of analyzing the factors that cause job incompatibility with the educational background of Automotive Engineering Vocational School graduates; and revealing the extent to which the Automotive Engineering Vocational School curriculum is aligned with the needs of the industrial world.

Method

This study used a quantitative correlational method to examine the relationship between automotive engineering competency (X1), type of work pursued (X2), and job suitability with educational background (Y) among graduates of Automotive Engineering Vocational High Schools (SMK) in Gunungsitoli.

Population and Sample

The study population was all graduates of Automotive Engineering Vocational High Schools (SMK) in Gunungsitoli in 2023-2024, totaling 276 students from the private SMK Pembda Nias and SMK Negeri 2 Gunungsitoli. The sampling technique used was cluster random sampling, randomly selecting several SMKs as clusters. The sample size was determined using the Slovin formula with a 5% margin of error, resulting in 163 respondents.

Operational Definition of Variables

Automotive Engineering Competency (X1): Technical ability of SMK graduates in the automotive field (repair, mechanical systems, diagnostics, occupational safety, and the latest technology). Measured by the total score of the instrument. Type of Work Engaged (X2): Type of work pursued by graduates (relevant/inappropriate). Measured by the total instrument score based on the field of work, position, relationship to competencies, reasons for choosing, and job stability. Job Suitability with Educational Background (Y): The degree to which graduates' jobs are relevant to the competencies acquired at the Automotive Engineering Vocational School. Measured by graduates' perceptions of the utilization of automotive skills in their work, knowledge utilization, and satisfaction.

Research Instrument

The main instrument was a closed-ended questionnaire with a 5-point Likert scale. This scale was used to measure respondents' perceptions, attitudes, and opinions. Instrument development involved: Developing a grid based on indicators; Developing statement items; Content validation by experts; Instrument pilot testing on 30 respondents who were not the main sample; Validity (Pearson product moment) and reliability (Cronbach's alpha) analysis using SPSS version 30.0.0. All 99 items (33 per variable) were found to be valid and reliable.

Data Collection Techniques

Data were collected through an online survey using Google Forms distributed through public communication platforms.

Data Analysis Techniques

Data were analyzed quantitatively using Microsoft Excel and SPSS version 30.0.0. Descriptive Analysis: Describes the frequency distribution of data (percentage, mode, median, mean) to determine the level of respondent achievement in each variable. Analysis Requirements Testing: Normality Test: Examines data distribution using the coefficient of variance value (<30% = normal); Linearity Test: Determines the linear relationship between variables (significance > 0.05 = linear); Independence Test: Checks for multicollinearity between independent variables.

Hypothesis Testing

Hypotheses 1 and 2 (X1 against Y, X2 against Y): Use correlation tests and simple regression (Product Moment) to determine the relationship and shape of the linear line. The t-test is used for significance.; Hypothesis 3 (X1 and X2 against Y simultaneously): Uses multiple regression to determine the correlation and joint effect. The F-test is used to examine the effect of the independent variables simultaneously. The coefficient of determination (KP) value and guidelines for the level of relationship will also be analyzed.

Results and Discussion

Data Description

The following description presents the research data, which includes Job Suitability (Y) as the dependent variable, Automotive Engineering Competence (X1), and Type of Job Engaged (X2) as the independent variables. This data description is conducted to describe the condition of each variable, including the mean, median, mode, standard deviation, minimum score, maximum score, and total score for each variable. The statistical calculations of the collected data for the three variables can be seen in Table 1.

Table 1. Description of research data Y, X1 and X2

		Statistics		
		Job Suitability (Y)	Automotive Engineering Competence (X1)	Type of Job Engaged (X2)
N	Valid	163	163	163
	Missing	0	0	0
Mean		124.12	109.67	111.58
Median		132.00	109.00	114.00
Mode		132	132	111
Std. Deviation		30.283	27.092	25.255
Variance		917.059	733.986	637.813
Range		121	125	130
Minimum		44	40	35
Maximum		165	165	165
Sum		20232	17877	18188

Based on Table 1, the data for these three variables are described as follows.

Job Suitability (Y)

Based on the Job Suitability variable data, the distribution of scores is spread from a minimum of 35 to a maximum of 165. From 163 respondents (N = 163), the mean score is 111.58, the median is 114.00, the most frequently occurring score (mode) is 111, the standard deviation is 25.255, and the variance is 637.813. To present Job Suitability data in the form of a frequency distribution and histogram, it is necessary to determine the number of classes and their class intervals as follows:

$$\text{Many classes (k)} = 1 + 3.30 \text{ Log N}$$
$$= 1 + 3.30 \text{ Log } 163$$
$$= 1 + 3.30 \times 2.21$$
$$= 1 + 7.30 = 8.30 \text{ taken } 8$$

$$\text{Interval} = \frac{\text{The highest score} - \text{Lowest value}}{\text{Many classes}} \quad (1)$$

$$= \frac{165 - 35}{8}$$
$$= 16.25 \text{ taken } 16$$

Table 2. Frequency distribution of job suitability variable scores (Y)

Interval Class (Y)	Frequency	Percentage (%)
35–50	5	3
51–66	5	3
67–82	12	7
83–98	17	10
99–114	43	26
115–130	48	29
131–146	23	14
147–165	10	6
Total	163	100

By paying attention to Table 2, a histogram of Job Suitability can be depicted as shown in Figure 1.

Based on Table 2, the frequency distribution of scores for the Job Suitability variable (Y), the data distribution demonstrates the diversity in job suitability

levels among Automotive Engineering Vocational High School graduates in Gunungsitoli. Of the 163 respondents, only 5 (3%) fell within the lowest score ranges, namely 35–50 and 51–66, indicating a very low level of suitability. A similar number was also found in the 51–66 range. This indicates that a small number of graduates experience difficulty finding jobs relevant to their educational background. Then, the number of respondents began to increase in the 67–82 range, with 12 respondents (7%), and more significantly in the 83–98 range, reaching 17 respondents (10%). This reflects that some graduates have a moderate level of suitability between their jobs and their education. The largest number of respondents fell within the 99–114 and 115–130 ranges, with 43 (26%) and 48 (29%) respondents, respectively.

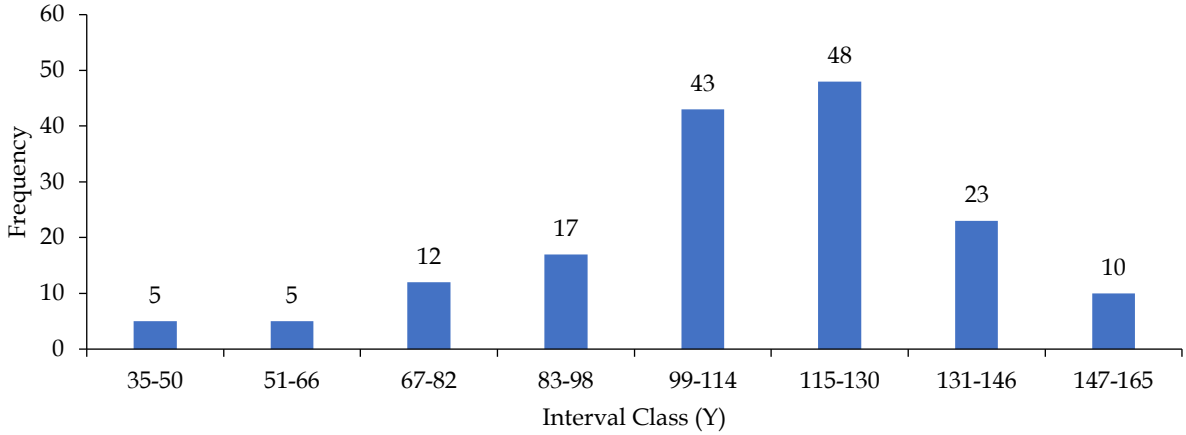

Figure 1. Job suitability histogram

This indicates that the majority of graduates have a fairly high level of match. In other words, the jobs they pursue are strongly related to the competencies they acquired during their vocational high school education. Furthermore, 23 respondents (14%) fell within the 131–146 range, and 10 respondents (6%) fell within the 147–165 range, indicating a very high level of match. This group likely consists of graduates who have successfully worked in the automotive sector or other fields that directly utilize automotive engineering skills. Overall, these data indicate that more than half of respondents (69%) have a fairly to very high level of match, a positive indicator of the relevance of their vocational education to job market needs. Conversely, a significant portion of graduates (around 13%) experienced a mismatch or only a slight connection between their jobs and their educational background. This distribution is visually depicted in the histogram in Figure 2, which shows a nearly normal curve, with a peak frequency in the upper-middle class. This pattern reflects the success of most graduates in securing suitable employment, although challenges remain for certain groups.

Automotive Engineering Competence (X1)

Based on the Automotive Engineering Competence variable data, the score distribution is spread from a minimum of 44 to a maximum of 165, from 163 respondents (N = 163), with an average score of 124.12, a median of 132.00, a frequently occurring score (mode) of 132, a standard deviation of 30.283, and a variance of 917.059. To present Automotive Engineering Competence data in the form of a frequency distribution and histogram, it is necessary to determine the number of classes and their class intervals as follows:

$$\begin{aligned}\text{Many classes (k)} &= 1 + 3.30 \text{ Log N}\\ &= 1 + 3.30 \text{ Log } 163\\ &= 1 + 3.30 \text{ x } 2.21\\ &= 1 + 7.30 = 8.30 \text{ taken } 8\end{aligned}$$

$$\text{Interval} = \frac{\text{The highest score} - \text{Lowest value}}{\text{Many classes}} \quad (2)$$

$$= \frac{165 - 44}{8}$$

$$= 15.125 \text{ taken } 15$$

To clarify the number of interval classes, the calculated interval classes are arranged in a frequency distribution list, as shown in Table 3.

Table 3. Frequency distribution of automotive engineering competency variable scores (X1)

Interval Class (Y)	Frequency	Percentage (%)
44–58	7	4
59–73	10	6
74–88	6	4
89–103	10	6
104–118	16	10
119–133	49	30

Interval Class (Y)	Frequency	Percentage (%)
134–148	29	18
149–165	36	22
Total	163	100

By paying attention to Table 3, a histogram of the types of work pursued can be depicted as shown in Figure 2.

Based on Table 3, which displays the frequency distribution of scores for the Automotive Engineering Competency variable (X1), it can be seen that the level of mastery of engineering competencies among graduates of Automotive Engineering Vocational Schools in Gunungsitoli shows quite wide variation. Of the 163 respondents, the smallest group was in the 74–88 range, with only 6 respondents (4%), and the 44–58 range, with 7 respondents (4%). This indicates that only a small proportion of graduates fall into the low engineering competency category. Furthermore, the 59–73 and 89–103 ranges each had 10 respondents (6%). These numbers are still relatively small and indicate that some graduates have not yet fully mastered the ideal automotive engineering competencies required by the workforce. The number of respondents began to increase significantly in the 104–118 range, with 16 respondents (10%), reflecting a group of graduates who already possess moderate engineering competencies.

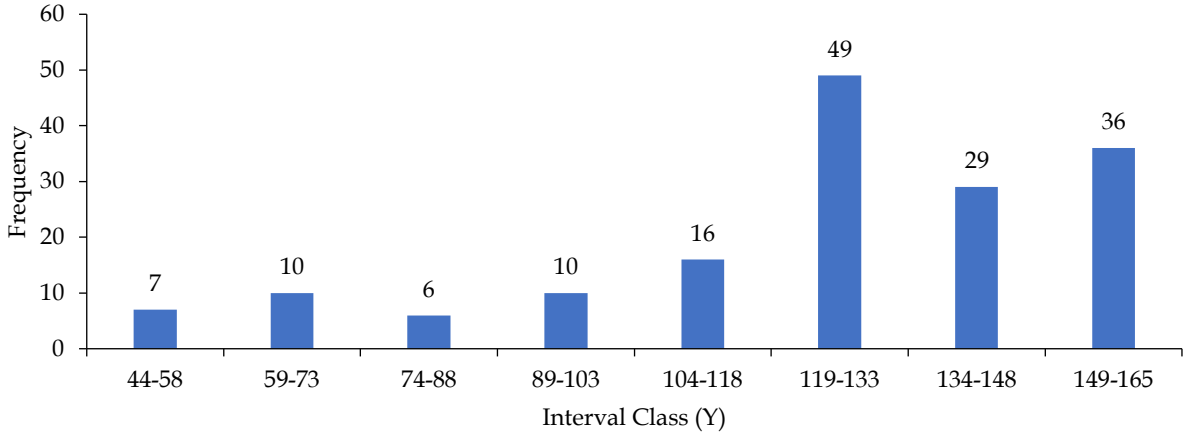

Figure 2. Histogram of automotive engineering competencies

The largest distribution was in the 119–133 range, with 49 respondents (30%). This group dominates the data and indicates that the majority of graduates possess strong automotive engineering competencies. A relatively high percentage was also found in the 134–148 range, with 29 students (18%), and the highest range, 149–165, with 36 students (22%). These two groups indicate graduates with high to very high mastery of automotive engineering competencies, and are likely to be optimally prepared for work in the automotive sector. Overall, 71% of respondents fell within the three highest ranges, 119–165. This illustrates that the majority of graduates possess good to very good levels of automotive engineering competency (Reig-Botella et al., 2022; Haryana et al., 2019; Budiman et al., 2020). This phenomenon indicates that the educational program at Automotive Engineering Vocational Schools (SMK) is relatively successful in equipping students with relevant technical skills (Ortiz-Marcos et al., 2020; Tenschert et al., 2024). The visual representation in the form of a histogram presented in Figure 3 reinforces this finding, with the peak distribution occurring in the upper-middle class. The resulting curve tends to slope to the left, indicating a concentration of frequencies in the high competency group. This pattern illustrates a positive trend in the technical readiness of vocational school graduates to enter the workforce, particularly in the automotive sector.

Type of Occupation (X2)

Based on the Type of Occupation variable data, the distribution of scores is known to range from a minimum of 40 to a maximum of 165. From 163 respondents (N = 163), the mean score is 109.67, the median is 109.00, the most frequently occurring score (mode) is 132.00, the standard deviation is 27.092, and the variance is 733.986. To present the Type of Occupation data in the form of a frequency distribution and histogram, it is necessary to determine the number of classes and their class intervals as follows:

Many classes (k) = 1 + 3.30 Log N
= 1 + 3.30 Log 163
= 1 + 3.30 x 2.21
= 1 + 7.30 = 8.30 taken 8

$$\text{Interval} = \frac{\text{The highest score} - \text{Lowest value}}{\text{Many classes}} \quad (3)$$

$$= \frac{165 - 40}{8}$$

$$= 15.625 \text{ taken } 16$$

To make the number of interval classes concrete, the number of interval classes that have been calculated are arranged in a frequency distribution list as shown in Table 4.

Table 4. Frequency distribution of scores for the type of work variable (X2)

Interval Class (Y)	Frequency	Percentage (%)
40–55	6	4
56–71	13	8
72–87	10	6
88–103	38	23
104–119	30	18
120–135	42	26
136–151	19	12
152–165	5	3
Total	163	100

By paying attention to Table 4, a histogram of the types of work pursued can be depicted as shown in Figure 3.

Based on Table 4, which presents the frequency distribution of scores for the Types of Jobs Engaged (X2) variable, respondents' scores vary, reflecting the relevance and diversity of the types of jobs pursued by Automotive Engineering Vocational High School graduates. Of the 163 respondents, only 6 (4%) fell within the lowest range, 40–55. This indicates that only a small proportion of graduates occupy jobs significantly outside their field of expertise (Tran et al., 2024). Furthermore, 13 respondents (8%) fell within the 56–71 range, and 10 respondents (6%) fell within the 72–87 range. These figures indicate that approximately 18% of graduates fall within the low level of job suitability. This group is most likely pursuing jobs outside the automotive industry or in fields that do not require the technical competencies they learned in vocational high school. The distribution peaks in the 88–103 and 120–135 intervals, with 38 respondents (23%) and 42 respondents (26%), respectively. These two intervals indicate that most graduates occupy jobs that are somewhat related to their automotive engineering expertise (Tran et al., 2024; López et al., 2023).

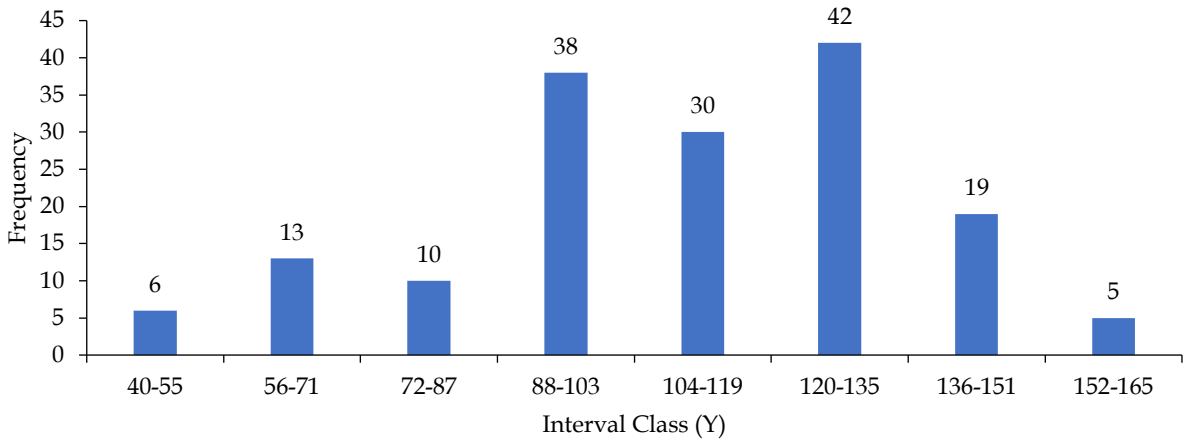

Figure 3. Histogram of types of jobs engaged

Discussion

This discussion examines research findings on the relationship between Automotive Engineering Competence (X1), Type of Job Engaged (X2), and Job Suitability (Y) among vocational high school graduates.

Relationship of Automotive Engineering Competence and Job Suitability

The analysis shows a positive relationship between automotive engineering competency (X1) and job suitability (Y). The average graduate competency is high (124.12 out of 165), with the majority falling in the high category for vehicle repair, mechanical systems, diagnostics, and especially soft skills (79.12%). This indicates that graduates with high competency tend to feel their jobs are a good fit. This finding aligns with the theory that mastering competencies increases the chances of finding relevant employment. Despite graduates' high competency, the job suitability level (Y) only shows a moderate category (average 111.58). This suggests that external factors such as limited job opportunities, economic conditions, and geography can influence suitability, even if graduates possess good competencies (Roša et al., 2025; Katnic et al., 2024; Peng et al., 2021). Thus, competency is important, but external

support (industry partnerships, job market information) is also crucial (Draissi et al., 2023; Fuertes et al., 2021).

Relationship between Type of Job Engaged and Job Suitability

There is a significant relationship between the type of job pursued (X2) and job suitability (Y). The average job type score was 109.67, indicating that graduates generally work in sectors somewhat related to the automotive industry. The "job field" indicator was high (70.33%), while "relationship to skills" and "reasons for choosing a job" were moderate (67.56 and 64.79%, respectively). This indicates a horizontal mismatch, where graduates work in fields related to the automotive industry but not specifically aligned with their core skills. External factors such as economic needs also play a role in job selection. The closer the job field is to competencies, the higher the perceived suitability (Diaa et al., 2024; Talluri & Uppal, 2023; Woo, 2020). Therefore, schools need to facilitate graduates' penetration into the automotive job market through career guidance and industry partnerships (Ahmad & Imam, 2022; Decius et al., 2024; Presti et al., 2022).

The Relationship between Automotive Engineering Competence and Type of Work Engaged in and Job Suitability

Both variables, Automotive Engineering Competence (X1) and Type of Work Engaged (X2), simultaneously contribute positively and significantly to Job Suitability (Y). Good competency (high category) provides the primary foundation for entering the relevant workforce. Job types that align with expertise also enhance suitability. Partial correlation analysis shows that even when the influence of Y is controlled, X1 and X2 remain positively and significantly related (0.330; $p < 0.001$). This indicates that they mutually support and are closely related in shaping job suitability. However, this relationship is not always linear, influenced by external factors such as job availability, location, and economic pressures. It is important for schools to not only equip technical competencies but also build industry networks and provide adaptive career guidance (Chollet et al., 2021; Pranckutė, 2021).

Research Limitations

This study has several limitations: The geographic scope is limited to Gunungsitoli City, so generalizing the findings to other regions requires caution. Data collection using online questionnaires (Google Forms) that rely on respondent subjectivity, potentially causing bias; Only analyzing three main variables, whereas many other factors (job interest, family background, access to information, policies) can influence job suitability. The quantitative approach limits the depth of information about graduates' personal experiences; Limited time and resources result in the potential for missing or not recording information optimally. Nevertheless, this study provides an accurate picture of the job suitability of graduates of Automotive Engineering Vocational Schools in Gunungsitoli and opens up opportunities for further research with broader scope, additional variables, and a mixed-methods approach.

Conclusion

This study concludes that the automotive engineering competencies of vocational high school graduates in Gunungsitoli are generally high, particularly in vehicle repair, mechanical systems, and soft skills. These competencies contribute significantly to graduates' perceived job suitability; the higher the competency, the greater the chance of finding relevant employment. Furthermore, the type of work pursued also influences suitability. Many graduates work in fields related to the automotive industry, although not always directly. The more relevant the type of work is to the automotive sector, the higher the perceived suitability. However, external factors such as economic pressures and limited job opportunities often push graduates to work outside their field. Simultaneously, competencies and job types contribute to job suitability. Strong competencies encourage graduates to seek relevant jobs, and relevant jobs strengthen perceived suitability. This suggests that job suitability is a combination of individual preparedness and labor market realities. In conclusion, vocational education must equip students with appropriate competencies, and close collaboration between schools, industry, and the government is needed to ensure graduates can work in their fields of expertise. Link and match efforts need to be optimized to ensure vocational high school graduates are truly absorbed in relevant sectors.

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Author Contributions

Conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing, preparation of the original draft, writing—review and editing, visualization, E.Z., A., M.G., and D.I.

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Conflicts of Interest

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References

Ahmad, R., & Imam, H. (2022). Roles of Competencies, Career Shock, and Satisfaction in Career Commitment: Evidence from Project-Based Organizations. *Project Leadership and Society*, *3*, 100052. https://doi.org/10.1016/j.plas.2022.100052

Ariansyah, K., Wismayanti, Y. F., Savitri, R., Listanto, V., Aswin, A., Ahad, M. P. Y., & Cahyarini, B. R. (2024). Comparing Labor Market Performance of Vocational and General School Graduates in Indonesia: Insights from Stable and Crisis Conditions. *Empirical Research in Vocational Education and Training*, *16*(1). https://doi.org/10.1186/s40461-024-00160-6

Bouw, E., Zitter, I., & Bruijn, E. D. (2019). Characteristics of Learning Environments at the Boundary between School and Work – A Literature Review. *Educational Research Review*, *26*, 1–15. https://doi.org/10.1016/j.edurev.2018.12.002

Budiman, A., Suyanto, W., & Efendi, Y. (2020). Mapping Graduate Learning Competencies of the Automotive Engineering Education. *Journal of Physics: Conference Series*, *1446*(1), 012035. https://doi.org/10.1088/1742-6596/1446/1/012035

Cavanagh, J., Burston, M., Southcombe, A., & Bartram, T. (2015). Contributing to a Graduate-Centred Understanding of Work Readiness: An Exploratory Study of Australian Undergraduate Students' Perceptions of Their Employability. *The International Journal of Management Education*, *13*(3), 278–288. https://doi.org/10.1016/j.ijme.2015.07.002

Chollet, B., Islam, G., & Ventolini, S. (2021). Everybody's Looking for Something: Developmental Networks as Subjective Career Relationships. *Journal of Vocational Behavior*, *124*, 103517. https://doi.org/10.1016/j.jvb.2020.103517

Decius, J., Knappstein, M., & Klug, K. (2024). Which Way of Learning Benefits Your Career? The Role of Different Forms of Work-Related Learning for Different Types of Perceived Employability. *European Journal of Work and Organizational Psychology*, *33*(1), 24–39. https://doi.org/10.1080/1359432x.2023.2191846

Diaa, N. M., Abidin, A. Z. U., & Roller, M. (2024). Examining the Relationship of Career Crafting, Perceived Employability, and Subjective Career Success: The Moderating Role of Job Autonomy. *Future Business Journal*, *10*(1). https://doi.org/10.1186/s43093-024-00304-w

Draissi, Z., Rong, Y., & Suliman, M. A. E. (2023). Employability and Education Mismatch in the Moroccan Urban Workplace. *Sage Open*, *13*(4). https://doi.org/10.1177/21582440231217890

Fuertes, V., McQuaid, R., & Robertson, P. J. (2021). Career-First: An Approach to Sustainable Labour Market Integration. *International Journal for Educational and Vocational Guidance*, *21*(2), 429–446. https://doi.org/10.1007/s10775-020-09451-2

García-Álvarez, J., Vázquez-Rodríguez, A., Quiroga-Carrillo, A., & Caamaño, D. P. (2022). Transversal Competencies for Employability in University Graduates: A Systematic Review from the Employers' Perspective. *Education Sciences*, *12*(3), 204. https://doi.org/10.3390/educsci12030204

Gumay, F. M., Distrik, I. W., Suyatna, A., & Azizah, M. (2024). Development of the Link and Match Learning Program Through the Application of the Dual-System Method to Support the Industrial Revolution 4.0 in Sinergy with Freedom to Learn. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 5789–5797. https://doi.org/10.29303/jppipa.v10i8.7337

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the Role of Digital Technologies in Education: A Review. *Sustainable Operations and Computers*, *3*, 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Haryana, K., Yoga, P. N. A., Sudiyanto, S., & Sutiman, S. (2019). Mapping the Graduate Quality of Automotive Engineering Education (S1) Study Program FT UNY. *Journal of Physics: Conference Series*, *1273*(1), 012034. https://doi.org/10.1088/1742-6596/1273/1/012034

Inderanata, R. N., & Sukardi, T. (2023). Investigation Study of Integrated Vocational Guidance on Work Readiness of Mechanical Engineering Vocational School Students. *Heliyon*, *9*(2), e13333. https://doi.org/10.1016/j.heliyon.2023.e13333

Katnic, I., Katnic, M., Orlandic, M., Radunovic, M., & Mugosa, I. (2024). Understanding the Role of Financial Literacy in Enhancing Economic Stability and Resilience in Montenegro: A Data-Driven Approach. *Sustainability*, *16*(24), 11065. https://doi.org/10.3390/su162411065

Kurniawan, R., Jaedun, A., Mutohhari, F., & Kusuma, W. M. (2021). The Absorption of Vocational Education Graduates in The Automotive Sector in The Industrial World. *Journal of Education Technology*, *5*(3). https://doi.org/10.23887/jet.v5i3.35365

López, P., Simó, P., & Marco, J. (2023). Understanding STEM Career Choices: A Systematic Mapping. *Heliyon*, *9*(6), e16676. https://doi.org/10.1016/j.heliyon.2023.e16676

Lu, D., & Xie, Y.-N. (2024). The Application of Educational Technology to Develop Problem-

Solving Skills: A Systematic Review. *Thinking Skills and Creativity*, *51*, 101454. https://doi.org/10.1016/j.tsc.2023.101454

Mainga, W., Murphy-Braynen, M. B., Moxey, R., & Quddus, S. A. (2022). Graduate Employability of Business Students. *Administrative Sciences*, *12*(3), 72. https://doi.org/10.3390/admsci12030072

Mohammed, F. S., & Ozdamli, F. (2024). A Systematic Literature Review of Soft Skills in Information Technology Education. *Behavioral Sciences*, *14*(10), 894. https://doi.org/10.3390/bs14100894

Mseleku, Z. (2022). From Workplace to Joblessness: The Determinants of Post-Internship Graduate Unemployment in South Africa. *Academic Journal of Interdisciplinary Studies*, *11*(2), 330. https://doi.org/10.36941/ajis-2022-0055

Nurmik, K., & Timoštšuk, I. (2024). Integrating Work-Life and Student Work-Related Experiences in Classroom Learning—The Perspective of Primary Teachers. *Social Sciences*, *13*(12), 649. https://doi.org/10.3390/socsci13120649

Orih, D., Heyeres, M., Morgan, R., Udah, H., & Tsey, K. (2024). A Systematic Review of Soft Skills Interventions within Curricula from School to University Level. *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1383297

Ortiz-Marcos, I., Breuker, V., Rodríguez-Rivero, R., Kjellgren, B., Dorel, F., Toffolon, M., Uribe, D., & Eccli, V. (2020). A Framework of Global Competence for Engineers: The Need for a Sustainable World. *Sustainability*, *12*(22), 9568. https://doi.org/10.3390/su12229568

Peng, P., Song, Y., & Yu, G. (2021). Cultivating Proactive Career Behavior: The Role of Career Adaptability and Job Embeddedness. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.603890

Pranckutė, R. (2021). Web of Science (WoS) and Scopus: The Titans of Bibliographic Information in Today's Academic World. *Publications*, *9*(1), 12. https://doi.org/10.3390/publications9010012

Presti, A. L., Capone, V., Aversano, A., & Akkermans, J. (2022). Career Competencies and Career Success: On the Roles of Employability Activities and Academic Satisfaction During the School-to-Work Transition. *Journal of Career Development*, *49*(1), 107–125. https://doi.org/10.1177/0894845321992536

Reig-Botella, A., Clemente, M., Detaille, S., Lange, A. H. D., & López-Golpe, J. (2022). Which Personal and Organizational Factors Influence the Organizational Commitment and Job Satisfaction of Shipyard Blue-Collar Workers? *International Journal of Environmental Research and Public Health*, *19*(8), 4849. https://doi.org/10.3390/ijerph19084849

Roša, A., Aldrena, A. M., & Lace, N. (2025). Evaluating Progress Toward Achieving the Quality of Employment and Decent Work: The Development of the Model. *Journal of Open Innovation: Technology, Market, and Complexity*, *11*(2), 100510. https://doi.org/10.1016/j.joitmc.2025.100510

Seo, W., & Lee, C. (2024). Why Do Vocational High School Students Opt for College? *Education Sciences*, *14*(5), 534. https://doi.org/10.3390/educsci14050534

Sevilla, M. P., Farías, M., & Luengo-Aravena, D. (2021). Patterns and Persistence of Educational Mismatch: A Trajectory Approach Using Chilean Panel Data. *Social Sciences*, *10*(9), 333. https://doi.org/10.3390/socsci10090333

Suyitno, S., Kamin, Y., Jatmoko, D., Nurtanto, M., & Sunjayanto, E. (2022). Industrial Apprenticeship Model Based on Work-Based Learning for Pre-Service Teachers in Automotive Engineering. *Frontiers in Education*, *7*. https://doi.org/10.3389/feduc.2022.865064

Talluri, S. B., & Uppal, N. (2023). Subjective Career Success, Career Competencies, and Perceived Employability: Three-Way Interaction Effects on Organizational and Occupational Turnover Intentions. *Journal of Career Assessment*, *31*(2), 397–419. https://doi.org/10.1177/10690727221119452

Tenschert, J., Furtner, M., & Peters, M. (2024). The Effects of Self-Leadership and Mindfulness Training on Leadership Development: A Systematic Review. *Management Review Quarterly*. https://doi.org/10.1007/s11301-024-00448-7

Tran, L. T., Ngo, N. T. H., Nguyen, H. T. M., Le, T. T. T., & Ho, T. T. H. (2024). "Employability in Context": Graduate Employability Attributes Expected by Employers in Regional Vietnam and Implications for Career Guidance. *International Journal for Educational and Vocational Guidance*, *24*(2), 375–395. https://doi.org/10.1007/s10775-022-09560-0

Wahyudi, K. S., Sulistyo, B., Budiman, A., & Arifin, Z. (2021). The Competency of Vocational Graduates in the Fields of Mechanics and Workshop Management According to the Needs of the Automotive Motorcycle Industry. *Journal of Physics: Conference Series*, *1833*(1), 012014. https://doi.org/10.1088/1742-6596/1833/1/012014

Wardani, L. M. I., Sekarini, D. A., Syaputra, R. D., Kartikawati, M. S., Dawanti, R., Mulia, D. D. A., & Malek, M. D. A. (2021). Career of Horizontal Education Mismatch Workers: Career Competency, Job Crafting, and Work Engagement. *Journal of Education and Learning (EduLearn)*, *15*(3), 414–424. https://doi.org/10.11591/edulearn.v15i3.19866

Woo, H. R. (2020). Perceived Overqualification and Job Crafting: The Curvilinear Moderation of Career Adaptability. *Sustainability*, *12*(24), 10458. https://doi.org/10.3390/su122410458

Zamiri, M., & Esmaeili, A. (2024). Strategies, Methods, and Supports for Developing Skills within Learning Communities: A Systematic Review of the Literature. *Administrative Sciences*, *14*(9), 231. https://doi.org/10.3390/admsci14090231