

Predictive Role of Industrial Practicum and Organizational Experience on Career Readiness of TVET Students

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Article Info

Article history:

Received June 30, 2026

Accepted August 25, 2026

Published September 05, 2026

Keywords:

Career Readiness;
Industrial Practicum;
Organizational Experience;
Predictive Model;
TVET Curriculum Expansion.

ABSTRACT

Addressing the career readiness gap in Technical and Vocational Education and Training (TVET) amid Industry 4.0 automation demands a dual integration of technical and interpersonal competencies. This study investigates the predictive role of industrial practicum experience and student organizational involvement on the career readiness of Electronics Engineering Education students. Employing a quantitative predictive-correlational research design, data were collected from N = 107 undergraduates selected via stratified random sampling from a population of N = 146 who had completed industrial internships and were active in campus organizations. Operationalized instruments measuring technical domain mastery, soft skills, and career adaptability were validated through expert judgment and pilot psychometric evaluation (Cronbach's $\alpha > .90$). Multiple linear regression analysis revealed that industrial practicum experience exerts a strong, dominant positive prediction on career readiness ($\beta = .667$, $t = 9.728$, $p < .001$), while organizational experience provides a moderate, complementary positive prediction ($\beta = .247$, $t = 3.602$, $p < .001$). The overall predictive model demonstrated significant explanatory power ($F(2, 104) = 136.883$, $p < .001$, $R = .851$), accounting for 72.5% of the total variance in career readiness ($R^2 = .725$, Adjusted $R^2 = .719$). These empirical findings demonstrate that while hands-on technical immersion during industrial practicums constitutes the backbone of vocational capability, organizational involvement critically reinforces interpersonal agility. The study provides actionable insights for TVET administrators to restructure internship frameworks and embed leadership competencies within technical laboratory curricula.

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1. INTRODUCTION

Technical and Vocational Education and Training (TVET) institutions worldwide face an unprecedented mandate to align academic preparation with the dynamic, automated environments of Industry 4.0 and Society 5.0 (Baharuddin et al., 2025; Parua & Yang, 2024). In the domain of electronics engineering education, the rapid

proliferation of smart manufacturing, Internet of Things (IoT) systems, and automated control frameworks has drastically altered entry-level job expectations (Ashour, 2023; Wong & Abdullah, 2025). High graduate unemployment rates across vocational disciplines underscore a persistent structural disconnect between institutional outputs and industrial requirements (Mason, 2020; Nurfadillah et al., 2025; Wardoyo et al., 2024). Consequently, fostering holistic career readiness—encompassing technical mastery, adaptive problem-solving, and interpersonal efficacy—has emerged as a central priority for TVET curriculum innovation (Nurtjahyadi et al., 2026).

Historically, vocational competence has relied heavily on experiential learning frameworks, particularly Work-Integrated Learning (WIL) and industrial practicums. Grounded in Kolb's Experiential Learning Theory, industrial practicums serve as a vital transition mechanism, enabling students to transform abstract theoretical concepts into real-world technical execution (Chand et al., 2023; James et al., 2024; Mayombe, 2024). Practical industrial immersion exposes students to authentic workflow constraints, advanced technological instruments, and organizational safety cultures that classroom settings cannot fully replicate (Đuriš et al., 2020; Mutambala et al., 2020). Empirical research confirms that industrial internships significantly enhance technical self-efficacy, work discipline, and operational agility (Achmad et al., 2023; Nugroho et al., 2020; Yulianti et al., 2023).

Concurrently, contemporary engineering education literature emphasizes that technical proficiency alone is insufficient for long-term career success. Modern engineering environments demand robust soft skills, including complex communication, cross-disciplinary teamwork, leadership, and emotional intelligence (Makki et al., 2023; Wilopo et al., 2025). Social Cognitive Career Theory posits that co-curricular experiences—such as active participation in student organizations—serve as critical mastery experiences that build self-efficacy and career decision-making capability (Gossen & Ivey, 2023). Student organizational leadership fosters non-technical competencies, enabling individuals to manage conflict, negotiate responsibilities, and perform under high-pressure group dynamics (Erlangga et al., 2024; Sulistyanto et al., 2025; Wijiharta, 2022).

Despite extensive research on work readiness predictors, a significant conceptual and empirical gap persists in current TVET literature. Existing studies predominantly analyze industrial internships and organizational participation in isolation or rely on descriptive, unintegrated frameworks (Aedi & Sukmawati, 2022; Cahyaningrum et al., 2023). Few studies have rigorously examined the relative predictive contribution and interaction between technical field exposure (hard skill focus) and organizational involvement (soft skill focus) within the specific context of electronics engineering education facing automated industrial transformations (Turangan et al., 2025; Vásquez, 2024). Furthermore, prior domestic studies frequently present fragmented data reporting without synthesizing predictive strength or evaluating pedagogical trade-offs.

To address these limitations, this study establishes an integrated predictive model evaluating how industrial practicum experience and organizational participation jointly and independently forecast the career readiness of Electronics Engineering Education

students. Rather than asserting direct causality through an experimental framework, this study employs a quantitative predictive-correlational methodology to delineate the relative weighting of hard and soft skill precursors. By identifying the dominant predictive drivers, this investigation aims to inform evidence-based TVET curriculum design, strategic internship scheduling, and co-curricular policy optimization.

2. METHOD

This study utilized a quantitative predictive-correlational research design to examine the relationship and predictive strength between two independent predictor variables—Industrial Practicum Experience (X_1) and Organizational Experience (X_2)—and one dependent criterion variable, Career Readiness (Y). Correlational designs are epistemologically appropriate for non-experimental educational research where variables cannot be manipulated directly but require systemic modeling to observe natural predictive relationships.

The target population comprised $N = 146$ active senior undergraduate students enrolled in the Electronics Engineering Education program at Universitas Negeri Makassar who had completed mandatory industrial internships and maintained active student status. Rather than relying on non-theoretical sample formulas, sample size determination was evaluated to ensure adequate statistical power for multiple regression modeling. A total sample of $n = 107$ students was selected using a stratified random sampling technique across three specialized study concentrations: Mechatronics Vocational Education (37.4%), Electronics Engineering Education (35.5%), and Electronics Engineering (27.1%). Inclusivity criteria required respondents to have completed a minimum of 8 weeks of industrial internship and at least 1 academic year of active participation in campus organizations. Demographic distribution confirmed participation across senior cohorts (56.1% cohort 2022; 43.9% cohort 2023).

Data were collected using a structured closed-ended survey questionnaire employing a 5-point Likert response scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). To guarantee measurement rigor, instruments were operationalized based on established theoretical frameworks:

- Industrial Practicum Experience (X_1): Operationalized across 8 items measuring technical equipment familiarity, industrial safety compliance, workflow adaptability, troubleshooting skills, and supervisor evaluation alignment (Cronbach's $\alpha = .957$).
- Organizational Experience (X_2): Operationalized across 9 items assessing interpersonal communication, group conflict management, event organizing, leadership responsibility, and organizational problem-solving (Cronbach's $\alpha = .944$).
- Career Readiness (Y): Operationalized across 6 core items capturing vocational self-knowledge, technical career adaptability, professional work ethics, stress tolerance, and job market self-efficacy (Cronbach's $\alpha = .947$).

Content validity was established through rigorous Content Validity Index (CVI) evaluation by a panel of three expert judges in TVET instructional design. Construct

validity and item discrimination were verified prior to main data collection via a pilot trial ($N = 20$). All preliminary items demonstrated item-total correlation coefficients exceeding the critical threshold ($r_{\text{calculated}} > .444$, $p < .001$). To mitigate Common Method Bias (CMB) inherent in self-reported survey data, procedural remedies were applied, including respondent anonymity, counterbalanced item ordering, and Harman's single-factor test, which confirmed that no single factor accounted for more than 42% of the variance.

Data was analyzed using IBM SPSS Statistics software. Statistical procedures encompassed descriptive statistics, diagnostic prerequisite testing (Kolmogorov-Smirnov and Shapiro-Wilk normality tests, linearity tests), Pearson product-moment correlation, and multiple linear regression analysis (t-test for partial contributions, F-test for model omnibus significance, and coefficient of determination R^2).

3. RESULTS AND DISCUSSION

Results

Diagnostic Prerequisite Testing

Prior to executing the primary multiple linear regression analysis, a rigorous diagnostic evaluation was conducted to verify that the empirical dataset fully met the classical assumptions required for parametric linear modeling. First, the assumption of residual normality was systematically examined by analyzing the standardized residuals. Statistical testing demonstrated that the residuals conformed to a normal distribution, as evidenced by non-significant results on both the Kolmogorov-Smirnov test ($D = 0.069$, $p = .200$) and the Shapiro-Wilk test ($W = 0.984$, $p = .229$). Furthermore, analysis of variance (ANOVA) linearity tests confirmed the presence of robust linear relationships between each independent variable and the dependent variable (Y). Specifically, the linear component for X_1 to Y accounted for a substantial proportion of variance ($F = 253.768$, $p < .001$), while the corresponding deviation from linearity was non-significant ($F = 1.630$, $p = .086$). Similarly, the pathway from X_2 to Y demonstrated significant linearity ($F = 103.133$, $p < .001$) alongside an acceptable, non-significant deviation from linearity ($F = 1.780$, $p = .063$), collectively supporting the specified linear functional forms.

Table 1. Diagnostic Prerequisite Testing

Diagnostic Test / Assumption	Statistical Test / Method	Statistical Results	Conclusion
Residual Normality	Kolmogorov-Smirnov Test & Shapiro-Wilk Test	Non-significant results ($p > 0.05$)	Residuals conform to a normal distribution
Linearity ($X_1 \rightarrow Y$)	ANOVA Test of Linearity	Significant linear component; non-significant deviation from linearity	Robust linear relationship confirmed
Linearity ($X_2 \rightarrow Y$)	ANOVA Test of Linearity	Significant linear component; non-significant deviation from linearity	Robust linear relationship confirmed

Second, the dataset was evaluated to ensure structural independence among predictors and to rule out multicollinearity issues that could distort parameter estimates. Multicollinearity diagnostic checks yielded favorable values well within standard empirical thresholds, showing a Variance Inflation Factor (VIF) of 1.780 (substantially below the conservative threshold of 10.0) and a corresponding Tolerance value of 0.562 (well above the critical cutoff of 0.10). These results indicate that inter-correlations among the explanatory variables (X_1 and X_2) do not introduce harmful collinearity, stabilizing the standard errors of the regression coefficients. Taken together, these diagnostic outcomes confirm that the underlying statistical assumptions of normality, linearity, and low multicollinearity are satisfied, establishing a robust foundation for reliable regression parameters and statistical inference.

Bivariate Correlation Analysis

Prior to testing the direct hypothesis models, a bivariate Pearson correlation analysis was conducted to examine the preliminary interrelationships among all measured variables. The statistical results revealed robust, positive correlations across all dimensions ($p < .001$), supporting the conceptual framework of the study. Specifically, Industrial Practicum Experience (X_1) demonstrated a strong positive association with Career Readiness (Y) ($r = .831, p < .001$), indicating that direct immersion in industry environments substantially aligns with enhanced student preparedness for the workforce. Similarly, Organizational Experience (X_2) exhibited a statistically significant positive correlation with Career Readiness ($r = .689, p < .001$), suggesting that active participation in co-curricular campus organizations contributes meaningfully to professional capacity building.

Table 2. Bivariate Pearson Correlation Matrix and Descriptive Results

Variables	Industrial Practicum Experience (X_1)	Organizational Experience (X_2)	Career Readiness (Y)	Conclusion
Industrial Practicum Experience (X_1)	—	Positive ($r < 0.85$)	Strong Positive ($r > 0, p < 0.05$)	Significant direct association; no multicollinearity issues
Organizational Experience (X_2)	Positive ($r < 0.85$)	—	Significant Positive ($r > 0, p < 0.05$)	Meaningful contribution to professional capacity building
Career Readiness (Y)	Strong Positive ($r > 0, p < 0.05$)	Significant Positive ($r > 0, p < 0.05$)	—	Dependent construct strongly supported by both predictors

Additionally, the analysis revealed a moderate, positive intercorrelation between the two predictor variables, Industrial Practicum Experience (X_1) and Organizational Experience (X_2) ($r = .662, p < .001$). This moderate alignment reflects the natural co-occurrence of practical field exposure and active co-curricular engagement among high-achieving vocational students, who frequently pursue complementary developmental

opportunities inside and outside the academic setting. Crucially, while this interrelationship highlights shared variance in experiential learning, the magnitude of the coefficient remains comfortably below critical collinearity thresholds ($r < .85$), confirming that X_1 and X_2 represent distinct theoretical constructs suitable for concurrent inclusion in multivariate modeling.

Multiple Linear Regression Model

To determine the predictive capacity and relative contribution weights of industrial practicum and organizational experience on career readiness, multiple linear regression analysis was executed. Table 3 summarizes the overall predictive regression model, ANOVA test, and partial parameter estimates.

Table 3. Summarizes the overall predictive regression model, ANOVA test, and partial parameter estimates

Model Predictors / Parameters	Unstandardized B	Std. Error	Standardized Beta (β)	t-statistic	Sig. (p)
(Constant)	6.422	1.395	-	4.603	< .001
Industrial Practicum (X_1)	0.404	0.042	0.667	9.728	< .001
Organizational Experience (X_2)	0.162	0.045	0.247	3.602	< .001
Model Fit Summary					
R = .851	R Square (R^2) = .725	Adjusted R^2 = .719	Std. Error = 1.286		
ANOVA Test Result	Sum of Squares	df	Mean Square	F-statistic	Sig. (p)
Regression Model	452.753	2	226.377	136.883	< .001

Note: Dependent Variable = Career Readiness (Y). N = 107. Predictors: (Constant), Organizational Experience (X_2), Industrial Practicum (X_1).

As detailed in Table 1, the omnibus regression model demonstrated high predictive validity ($F(2, 104) = 136.883, p < .001$). The model yielded an overall correlation coefficient of $R = .851$ and a coefficient of determination of $R^2 = .725$ (Adjusted $R^2 = .719$). This indicates that 72.5% of the total variance in students' career readiness is directly explained by the combined linear prediction of industrial practicum and organizational experience, with the remaining 27.5% attributed to unmeasured extraneous factors.

Evaluating individual standardized regression weights reveals a pronounced discrepancy in predictive impact between the two antecedents. Industrial Practicum Experience (X_1) emerged as the primary, dominant predictor of career readiness ($\beta = .667, t = 9.728, p < .001$). Conversely, Organizational Experience (X_2) demonstrated a statistically significant but substantially smaller complementary prediction ($\beta = .247, t = 3.602, p < .001$). The resulting unstandardized regression equation for forecasting career readiness is modeled as:

$$\hat{Y} = 6.422 + 0.404(X_1) + 0.162(X_2)$$

Discussion

The empirical findings of this study provide crucial theoretical and practical insights into the developmental mechanics of career readiness among vocational engineering undergraduates. The confirmed multiple regression model ($R^2 = .725$) establishes that industrial practicums and student organizational experiences operate as complementary drivers of graduate employability, confirming core tenets of Experiential Learning Theory by Kolb ([Henríquez et al., 2025](#)) and Social Cognitive Career Theory ([Lent & Brown, 2019](#)). By demonstrating how experiential knowledge acquisition translates into heightened occupational confidence, these results underscore the systemic interplay between formal curriculum immersion and co-curricular engagement. Furthermore, the robust explanatory power of the model indicates that career readiness in applied engineering fields is not a singular trait, but rather a multi-faceted construct shaped by both structured technical environments and collaborative social contexts.

A central, critical insight of this research lies in the overwhelming dominance of Industrial Practicum Experience ($\beta = .667$) relative to Organizational Experience ($\beta = .247$) in predicting career readiness. In technical disciplines such as Electronics Engineering Education, career readiness is heavily anchored in domain-specific technical mastery, equipment operation fluency, and familiarity with automated industrial standards ([Ashour, 2023](#); [Wong & Abdullah, 2025](#)). Direct industrial exposure provides contextualized learning environments where students confront real-world technical troubleshooting, safety protocols, and corporate production standards that simulated campus laboratories cannot fully replicate ([Chand et al., 2023](#); [Tkacuk, 2024](#)). Consequently, these findings reinforce prior global TVET literature demonstrating that hands-on internship immersion directly elevates vocational self-efficacy and job market adaptability ([Achmad et al., 2023](#); [Pérez Gutiérrez et al., 2024](#); [Yulianti et al., 2023](#)).

Conversely, while organizational participation exhibited a lower beta weight ($\beta = .247$), its statistically significant contribution ($p < .001$) highlights the indispensable role of soft skills in modern engineering environments. Electronics engineers do not work in isolation; they function within multidisciplinary project teams requiring interpersonal communication, leadership, conflict resolution, and adaptive problem-solving ([Makki et al., 2023](#); [Mulyana & Linando, 2025](#)). Active organizational involvement serves as an experimental arena for mastering non-technical competencies, enabling students to navigate complex group dynamics and professional accountability ([Rosyida et al., 2025](#); [Sulistyanto et al., 2025](#)). Thus, soft skills developed through campus leadership act as a secondary, stabilizing layer that complements primary technical expertise, ensuring graduates can effectively deploy their practical know-how within complex workplace structures.

Comparing these results with broader international VET discourse reveals significant alignment with work-integrated learning frameworks observed in advanced industrial economies ([Jalinus et al., 2023](#); [Mutambala et al., 2020](#); [Pradipta et al., 2021](#)). However, this study expands existing knowledge by clarifying the structural hierarchy of influence: soft skills and organizational leadership serve as key differentiators only

when grounded upon a solid foundation of technical industrial competence. Without fundamental technical literacy and hands-on operational capability, interpersonal competencies alone are insufficient to meet the rigorous demands of technical engineering roles. This dynamic emphasizes that co-curricular activities augment, rather than replace, core industrial training in shaping competitive vocational profiles.

Several methodological limitations must be acknowledged when interpreting these conclusions. First, the cross-sectional, self-reported survey design introduces potential response bias, although diagnostic common method bias (CMB) tests indicated acceptable levels that do not undermine the empirical integrity of the findings. Second, while the sample size ($n = 107$) possessed sufficient statistical power for regression modeling within this specific institutional context, generalizing findings across non-technical TVET disciplines or vastly different regional markets should be undertaken cautiously. Scholars should consider these sampling boundaries when adapting the theoretical model to broader vocational educational frameworks.

Finally, extraneous psychological and contextual variables—such as intrinsic work motivation, individual self-efficacy baseline, and mentor support quality—were not explicitly integrated into the primary regression model. Future research should leverage longitudinal architectures and structural equation modeling (SEM) to trace how these latent psychological determinants interact with industrial and organizational experiences over time. Incorporating such multi-dimensional variables will provide a more comprehensive understanding of the pathways through which vocational undergraduates transition into the modern engineering workforce.

4. CONCLUSION

This study conclusively demonstrates that industrial practicum experience and student organizational involvement jointly function as powerful predictors of career readiness among Electronics Engineering Education undergraduates, explaining 72.5% of overall variance ($R^2 = .725$, $p < .001$). Grounded in empirical multiple regression analysis, the investigation establishes a clear developmental hierarchy: direct technical immersion during industrial practicums constitutes the primary, dominant driver of vocational readiness ($\beta = .667$), while co-curricular organizational leadership provides a crucial, complementary foundation of non-technical agility ($\beta = .247$). Consequently, achieving optimal graduate employability in modern TVET requires an integrated educational ecosystem that synergizes rigorous technical field training with structured soft-skill cultivation.

To operationalize these empirical insights, TVET higher education administrators and curriculum designers must systematically restructure mandatory industrial practicum frameworks by extending internship durations, establishing formal Industry-Academia Co-Design Committees, and transitioning learning contracts from passive observation toward project-based industrial assignments centered on Industry 4.0 automation competencies. Simultaneously, technical departments should embed structured team leadership, project management, and collaborative communication modules directly into laboratory coursework to cultivate essential interpersonal

capabilities among students who do not actively participate in campus organizations. Complementing these institutional interventions, future research should employ longitudinal experimental architectures tracking graduate career trajectories over a three-to-five-year post-graduation window while incorporating key mediating constructs—such as career self-efficacy, mentorship quality, and digital literacy—across multi-institutional TVET cohorts to provide a more holistic understanding of vocational career readiness.

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