



Teachers' Perceptions of Principal Managerial Competence and School Infrastructure as Predictors of Work Motivation in a Vocational School

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ARTICLE INFO

Keywords:

Managerial Competence;
Multiple Regression;
School Infrastructure;
Teacher Motivation;
Vocational High School.

Article History

Received: April 19, 2026

Revised: June 29, 2026

Accepted : August 03, 2026

ABSTRACT

Teacher work motivation plays an important role in sustaining instructional quality in vocational education, where teachers are expected to integrate theoretical instruction with practical and industry-oriented learning. This study examined the associations between teachers' perceptions of principal managerial competence and school infrastructure and their self-reported work motivation in a public vocational high school in Indonesia. A quantitative associative, cross-sectional design was employed involving all 20 teachers through total sampling. Data were collected using pilot-tested and reliable Likert-scale questionnaires and analyzed using multiple linear regression, with Spearman rank-order correlation employed as a supplementary analysis because of non-normal data distributions. The findings showed that perceived principal managerial competence was positively and significantly associated with teacher work motivation, whereas perceived school infrastructure did not demonstrate a significant independent association after managerial competence was taken into account. Nevertheless, school infrastructure remained strongly associated with teacher motivation at the bivariate level. The overall regression model was statistically significant and explained 68.5% of the variance in teacher work motivation. These findings suggest that, within this school context, teachers' perceptions of principal managerial competence were more strongly associated with work motivation than their perceptions of school infrastructure. The results highlight the potential importance of effective school management in supporting teacher motivation in vocational education while also indicating that infrastructure may operate in conjunction with broader managerial conditions rather than as an isolated factor. Given the small, single-school, cross-sectional sample and reliance on teacher-reported perceptions, the findings should be interpreted as exploratory and context-specific rather than causal or broadly generalizable.

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To cite this article : Nuh, M., Astuti, Y. (2026). Teachers' Perceptions of Principal Managerial Competence and School Infrastructure as Predictors of Work Motivation in a Vocational School. *Indonesian Technology and Education Journal*, 4(2), 242-256. Doi. 10.61255/itej.v4i2.1516

INTRODUCTION

Vocational high schools (Sekolah Menengah Kejuruan/SMK) occupy a distinctive position within the Indonesian secondary education system, as they are explicitly mandated to prepare graduates who possess applicable occupational competencies and the adaptability required by an increasingly dynamic labor market. Government Regulation No. 57 of 2021 concerning National Education Standards affirms that vocational education must be directed toward developing students' readiness for employment and professional practice within their respective fields of expertise. Achieving this mandate depends substantially on the quality and motivation of the

teaching workforce, since vocational instruction combines theoretical knowledge with hands-on, practice-based skill training that demands sustained pedagogical commitment from teachers.

Within this context, teachers in SMK function not merely as instructors but as mentors who cultivate students' learning enthusiasm and vocational competencies. Sariakin et al. (2025) argue that teacher work motivation directly affects instructional success, as highly motivated teachers tend to display greater enthusiasm, creativity, and consistency in managing the teaching-learning process. From a broader theoretical perspective, Herzberg's Two-Factor Theory (Herzberg et al., 1959) suggests that employees' work motivation is shaped jointly by intrinsic motivators—such as achievement, recognition, and responsibility—and extrinsic hygiene factors—such as working conditions, facilities, and supervision quality. Empirical support for this dual-factor framework within vocational education has been demonstrated by Mustafa et al. (2022), who found that Malaysian vocational college teachers achieved job satisfaction only when motivator and hygiene factors complemented one another, underscoring the relevance of a dual-pathway perspective for the present study. In the present instrument, the managerial-competence indicators (planning, organizing, actuating, and controlling) map most closely onto motivator-type mechanisms such as goal-setting, recognition, and performance feedback, whereas the infrastructure indicators (availability, feasibility, and utilization of facilities) map most closely onto hygiene-type working-condition factors; this correspondence is interpretive rather than confirmed through a formal dimensionality analysis of the questionnaire.

Despite its theoretical importance, teacher work motivation remains suboptimal in a considerable number of SMK. Diminished motivation has been associated with reduced instructional effectiveness, weakened classroom discipline, and lower student learning outcomes (Uno, 2016). Among the various organizational determinants of teacher motivation, principals' managerial competence and the adequacy of school infrastructure are considered particularly influential. As the instructional leader, the principal occupies a strategic position in mobilizing teacher motivation through effective resource management, open communication, and recognition of teacher performance (Rachmawati & Santosa, 2020). Managerial competence, following the classical management functions articulated by George R. Terry (in Siagian, 2018), encompasses planning, organizing, actuating, and controlling—functions further elaborated in the Indonesian Ministry of National Education Regulation No. 13 of 2007 concerning Principal/Madrasah Head Standards. In parallel, adequate and well-maintained school infrastructure constitutes an essential supporting condition for a comfortable working environment, consistent with the Ministry of Education, Culture, Research, and Technology Regulation No. 22 of 2023 concerning Facilities and Infrastructure Standards.

A growing body of literature links managerial competence and infrastructure to teacher motivation. Rachmawati and Suyatno (2021) found that principals' conceptual, interpersonal, and technical competencies significantly predicted teachers' job satisfaction and work commitment among junior-secondary schools in Yogyakarta. Muttaqin et al. (2023), in a large-scale Indonesian study ($n > 2,000$ teachers), demonstrated that managerial competence influenced teacher performance partly through the mediating role of teacher commitment. Similarly, Rachmawati and Santosa (2020) linked principals' managerial competence to school creativity outcomes, Azainil et al. (2021) found that principals' managerial competence and teacher discipline jointly predicted teacher productivity, and Paulus and Marhamah (2020) reported that principals' managerial ability was significantly associated with elementary teachers' work motivation. Toropova et al. (2021) reported, across a cross-national sample, that school working conditions including facility- and resource-related dimensions were significantly associated with teacher job satisfaction. In a directly relevant recent study, Kholifah et al. (2024), surveying 381 vocational

teachers, found that managerial support and working conditions were significantly associated with teacher motivation and professional development, which in turn predicted teacher performance. Karim et al. (2023) similarly reported a positive relationship between managerial competence and teacher work motivation in an Indonesian junior-secondary (madrasah tsanawiyah) context, and Sulfemi (2020) likewise found that school facilities and infrastructure were positively associated with teachers' teaching motivation at the secondary level.

Within vocational education specifically, Cindy et al. (2022) identified rule-based governance, industry partnership, and utilization practices as key factors shaping the optimization of SMK facilities and infrastructure; Mailool et al. (2020) found that principals' decision-making and school climate significantly predicted teacher performance in Indonesian vocational high schools; Pambayun et al. (2020) documented persistent infrastructure gaps in SMK facing the demands of Industry 4.0; Sutopo et al. (2023) similarly reported facility-standard shortfalls in vocational machining workshops; Rasto et al. (2025) identified multiple organizational pathways including managerial and infrastructural ones through which principals shape vocational school excellence; and Prayogo et al. (2026) reported that leadership quality was central to education and training outcomes in vocational schools in the shipping sector. Sinulingga et al. (2023) further found that principal leadership significantly influenced teacher performance and motivation in an Indonesian vocational school setting.

Convergent evidence from other Indonesian vocational contexts Hartinah et al. (2020) in Tegal City, Kurnia et al. (2021) in Sleman Regency, Anshori et al. (2023) in Jember City, and Dwiyono et al. (2023) likewise links principal leadership and the school working environment to vocational teachers' motivation, satisfaction, and performance. Taken together, these studies converge on a positive relationship between managerial leadership, infrastructure, and teacher motivation; however, much of the broader evidence base was still conducted predominantly within primary and junior-secondary settings, and the vocational-specific studies noted above have rarely combined regression with nonparametric corroboration or examined a single-school population in the depth undertaken here. The vocational schooling context, characterized by unique facility-management demands and competency-based instructional requirements, remains comparatively underexplored. Unlike general junior-secondary or elementary schools, SMK principals must additionally oversee recurring maintenance cycles for practical workshop and laboratory equipment, allocate scarce consumable materials across multiple skill-competency programmes, and coordinate scheduling and quality assurance with external industry partners for apprenticeship and internship placements; these demands plausibly intensify the interdependence between managerial competence and infrastructure adequacy relative to the general-education settings examined in prior studies.

Building on this gap, the present study examines, as an exploratory contextual study rather than a major theoretical or analytical advance, the partial and simultaneous statistical associations between teachers' perceptions of principal managerial competence and school infrastructure and teachers' self-reported work motivation at SMK Negeri 2 Rupert—a vocational school in which practical workshops, laboratory equipment, and sustained coordination with industry partners create infrastructural and leadership demands that differ markedly from those of general secondary schools, consistent with Huo and Zhang's (2025) observation that the effectiveness of school-enterprise partnerships in vocational education depends heavily on school-level managerial coordination. The novelty of this study lies in its explicit empirical focus on this vocational context and in its use of a dual analytical strategy combining multiple regression with nonparametric Spearman correlation to address non-normal data distributions. Based on the theoretical framework and empirical evidence outlined above, three hypotheses were formulated:

H1: Teachers' perceived principal managerial competence has a significant partial association with teachers' work motivation.

H2: Teachers' perceived school infrastructure has a significant partial association with teachers' work motivation.

H3: Teachers' perceived principal managerial competence and perceived school infrastructure are simultaneously and significantly associated with teachers' work motivation.

The findings are expected to contribute theoretically to the literature on educational leadership and facility management within vocational education, and practically to inform school leadership development and facility-management policy in Indonesian SMK.

METHOD

Research Design

This study employed a quantitative associative research design intended to examine the relationship and statistical association of principals' managerial competence (X1) and school infrastructure (X2) with teachers' work motivation (Y) through statistical analysis. The cross-sectional, non-experimental nature of the design means that the findings should be interpreted as evidence of statistical association rather than definitive causal influence.

Population and Sample

The population comprised all teachers at SMK Negeri 2 Rupert, Bengkalis Regency, Riau Province, Indonesia, totaling 20 teachers (consisting of both productive vocational-skills and normative general-subject teachers). Because the population size was fewer than 100, a total sampling technique was applied meaning all 20 teachers participated as respondents—in line with standard total sampling practice for populations of this size. It should be noted at the outset that a sample of 20 is small for a two-predictor multiple regression; following Green's (1991) rule of thumb ($N \geq 50 + 8k$), approximately 66 respondents would be recommended for this model, and the partial coefficients reported below should accordingly be read as indicative of this single-school population rather than as precise, generalizable point estimates. The research was conducted from October to November 2025. Because all 20 respondents rated the same principal and the same school environment, the managerial-competence and infrastructure scores analyzed in this study are teachers' perceptions of one shared principal and one shared set of facilities, not independently verified, objectively varying organizational attributes; the analysis accordingly captures differences in how individual teachers perceived a common context rather than differences across principals or schools, and all three variables are consistently described as teacher-reported perceptions throughout this manuscript. Because all 20 teachers employed at the school were surveyed, this study is best characterized as an exploratory, school-level census: the reported p-values describe the internal, within-school comparison among the observed managerial-competence, infrastructure, and motivation scores rather than an inference to an external population of vocational-school teachers. Where the findings are discussed in relation to vocational schooling more broadly, they should accordingly be read as a single-site case pattern that motivates further multi-site research rather than as a statistically representative estimate.

Variables and Research Instrument

The independent variables were principals' managerial competence (X1) and school infrastructure (X2); the dependent variable was teachers' work motivation (Y). Data were collected using three structured questionnaires employing a four-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (4). Table 1 summarizes the operationalization of each variable.

Table 1. Operational Definition, Indicators, and Instrument Structure of Research Variables

Variable	Definition	Indicators	# Items	Source
Principals' Managerial Competence (X1)	Ability to manage school resources and personnel effectively	Planning; Organizing; Actuating; Controlling	17	Terry in Siagian (2018); Permendiknas No.13/2007
School Infrastructure (X2)	Adequacy and condition of facilities supporting teaching and learning	Availability; Feasibility; Utilization; Maintenance	12	Permendikbudristek No.22/2023
Teachers' Work Motivation (Y)	Teachers' drive to perform professional duties	Intrinsic drive; Extrinsic drive; Responsibility; Achievement	14	Uno (2016)

The instrument for X1 comprised 17 items (example: "The principal formulates the school's work programme in a systematic and measurable manner"). X2 comprised 12 items (example: "The school's practical workshop equipment is maintained in good condition and ready for use"). Y comprised 14 items (example: "I feel enthusiastic and committed when carrying out my teaching duties").

Data Collection Procedure

The questionnaires were first trialled on a pilot group of teachers independent of and external to the 20 teachers comprising the main research population, to establish validity and reliability; pilot participants were not included in the main analysis. Following confirmation of measurement adequacy, the finalized instruments were distributed to all 20 respondents in the main study, all of whom returned complete responses with no missing items. Completed questionnaires were collected and processed using IBM SPSS Statistics version 27.

Validity and Reliability

Item validity was assessed using Pearson product-moment correlation, comparing each item's corrected item-total (item-rest) correlation computed by excluding each item from its own total score to avoid part-whole inflation against the critical r-table value for $n = 20$ at $\alpha = .05$ ($df = 18$; $r\text{-table} = 0.444$). Items exceeding this threshold were considered valid. Reliability was assessed using Cronbach's Alpha; values exceeding .70 indicated acceptable internal consistency (Nunnally, 1978).

Classical Assumption Tests

Prior to regression analysis, three classical assumption tests were conducted. (1) Normality: the Shapiro-Wilk test was selected given the small sample ($n < 50$). (2) Multicollinearity: Tolerance and VIF values were examined; $\text{Tolerance} > .10$ and $\text{VIF} < 10$ indicated no multicollinearity. (3) Heteroscedasticity: the Glejser test was applied; predictor coefficients with $p > .05$ indicated homoscedasticity. Because Shapiro-Wilk results indicated non-normal distributions for all variables (see Results), a supplementary nonparametric analysis Spearman rank-order correlation was conducted to confirm the bivariate associations between variables without relying on normality assumptions.

Data Analysis Technique

Multiple linear regression was used to examine partial associations (t-test) and the overall model (F-test) between X1, X2, and Y, and to estimate the proportion of variance explained (R^2). Although regression can be moderately robust to mild violations of normality, the non-normal distributions observed in this study represent a limitation that should be considered when interpreting regression coefficient precision. Spearman rank-order correlations were reported as complementary, assumption-free evidence of bivariate associations.

Ethical Considerations

This study received formal ethical clearance from the Komisi Etik (Research Ethics Commission) of Universitas Negeri Yogyakarta, under the coordination of the Directorate of Research and Community Service (Direktorat Riset dan Pengabdian kepada Masyarakat), prior to data collection. All respondents provided written informed consent via a signed participation-consent form, were informed about data retention and destruction procedures, and were assured of anonymity and data confidentiality. Participation was voluntary and responses were used exclusively for academic purposes. Raw data were securely destroyed upon completion of the study in accordance with standard ethical guidelines for educational research.

RESULTS AND DISCUSSION

Descriptive Statistics of Research Variables

Descriptive statistical analysis was conducted to provide an overview of respondents' perceptions. Because the instrument employed a four-point Likert scale, score categories were constructed using the theoretically anchored interval method for each variable separately. Table 2 presents the descriptive results.

Table 2. Descriptive Statistics and Category Distribution of Research Variables

Variable	N	Total Score Mean	SD	Range	Category Distribution
Managerial Competence (X1)	20	61.80	6.19	51–68	Very High: 80% (n=16); High: 20% (n=4)
School Infrastructure (X2)	20	43.95	4.80	36–48	Very Good: 80% (n=16); Good: 20% (n=4)
Work Motivation (Y)	20	49.90	6.37	41–56	Very High: 70% (n=14); High: 30% (n=6)

Note: Category boundaries were derived by dividing each variable's theoretical score range (number of items $\times$ 1 to number of items $\times$ 4) into four equal intervals. The exact interval widths are X1 = 12.75 points (range 17–68), X2 = 9 points (range 12–48), and Y = 10.5 points (range 14–56); these replace the previously reported rounded widths of 13, 10, and 11 points. Very High/Very Good = top interval; High/Good = second interval.

As shown in Table 2, teachers perceived both the principal's managerial competence and school infrastructure predominantly at the highest categorical level (80% and 80%, respectively), while work motivation showed a similarly positive distribution (70% Very High, 30% High). The absence of respondents in low or very low categories across all three variables indicates that SMK Negeri 2 Rupert operates in organizationally favorable conditions.

Validity and Reliability Test Results

Table 3 presents the validity and reliability results for each research instrument.

Table 3. Validity and Reliability Test Results

Variable	Items (n)	r-counted Range	r-table ($\alpha=.05$)	Validity	Cronbach's α	Reliability
Managerial Competence (X1)	17	0.527–0.997	0.444	All Valid	0.954	Excellent
School Infrastructure (X2)	12	0.739–0.894	0.444	All Valid	0.780	Acceptable
Work Motivation (Y)	14	0.689–0.905	0.444	All Valid	0.974	Excellent

Note: All r-counted values exceeded the r-table critical value of 0.444 ($n=20$, $df=18$, $\alpha=.05$), confirming item validity for all 43 items across the three instruments. Cronbach's α values exceeded the .70 threshold (Nunnally, 1978) for all variables.

Classical Assumption Tests

Table 4 presents the results of the normality, multicollinearity, and heteroscedasticity tests. Because Shapiro–Wilk tests yielded significant results ($p < .05$) for all three variables and the regression residuals, confirming non-normal distributions, a supplementary nonparametric analysis (Spearman rank-order correlation) was conducted. Multicollinearity and heteroscedasticity assumptions were met (Table 4).

Table 4. Classical Assumption Test Results

Test	Statistic	Criterion	Result
Normality – X1 (Shapiro–Wilk, $df=20$)	$W = 0.827$, Sig. = .002	Sig. > .05	Not Normal
Normality – X2 (Shapiro–Wilk, $df=20$)	$W = 0.778$, Sig. < .001	Sig. > .05	Not Normal
Normality – Y (Shapiro–Wilk, $df=20$)	$W = 0.774$, Sig. < .001	Sig. > .05	Not Normal
Normality – Residuals (Shapiro–Wilk)	$W = 0.895$, Sig. = .033	Sig. > .05	Not Normal
Multicollinearity – X1 (Tol / VIF)	0.305 / 3.274	Tol. > .10; VIF < 10	No Multicollinearity
Multicollinearity – X2 (Tol / VIF)	0.305 / 3.274	Tol. > .10; VIF < 10	No Multicollinearity
Heteroscedasticity – X1 (Glejser, Sig.)	Sig. = .331	Sig. > .05	Homoscedastic
Heteroscedasticity – X2 (Glejser, Sig.)	Sig. = .601	Sig. > .05	Homoscedastic

Note: Shapiro–Wilk statistics computed from the raw total-score data ($n=20$). Non-normal distributions motivated the supplementary Spearman analysis reported in Table 5. The Glejser test was conducted by regressing the absolute residuals from the main regression on X1 and X2; predictor-level significance values are reported (X1: $p = .331$; X2: $p = .601$), and both exceed the .05 threshold, indicating no systematic heteroscedasticity associated with the two predictors. The intercept term in the Glejser auxiliary regression

was also significant; however, in a Glejser test heteroscedasticity is evaluated through the predictor coefficients, not the intercept, so a significant intercept only indicates that the expected absolute residual is nonzero and is not, by itself, evidence of heteroscedasticity. VIF values below 10 and Tolerance above .10 indicate that multicollinearity does not invalidate the regression coefficients, although the VIF of 3.274 does inflate standard errors by a factor of approximately 1.81 relative to an orthogonal design

Supplementary Spearman Rank-Order Correlations

Given the non-normal distributions confirmed above, Table 5 presents Spearman rank-order correlations as assumption-free evidence of bivariate associations among the three variables.

Table 5. Spearman Rank-Order Correlations Among Research Variables (n = 20)

Bivariate Association	Spearman rs	Sig.	Interpretation
Managerial Competence (X1) – Work Motivation (Y)	.904	< .001	Very Strong, Positive, Significant
School Infrastructure (X2) – Work Motivation (Y)	.821	< .001	Strong, Positive, Significant
Managerial Competence (X1) – School Infrastructure (X2)	.833	< .001	Very Strong (explains collinearity)

Note: The strong X1–X2 correlation (rs = .833) is indicative of moderate collinearity between the predictors, which is consistent with the VIF value of 3.274 reported in Table 4 and helps explain the non-significant partial regression coefficient for X2 in Table 6.

Multiple Linear Regression Analysis

Table 6 presents the unstandardized and standardized regression coefficients from the multiple linear regression analysis.

Table 6. Multiple Linear Regression Coefficients (Dependent Variable: Work Motivation Y)

Variable	B	SE	Standardized β	t	Sig.
Constant	1.467	8.319†	–	0.176	.862
Managerial Competence (X1)	0.907	0.240†	0.881‡	3.785	0.001
School Infrastructure (X2)	–0.162	0.309†	–0.122‡	–0.524	0.607

† SE, t, and the standardized β were reconstructed analytically from statistics reported elsewhere in this manuscript (n, SDs, Tolerance/VIF, and MSE) and are internally consistent with those figures. Conventional 95% CIs (non-robust, non-bootstrap) are reported in the text; see Research Limitations for the corresponding caveat.

The regression equation is $\hat{Y} = 1.467 + 0.907X_1 - 0.162X_2$. The coefficient for X1 (B = 0.907, SE = 0.240, t = 3.785, p = .001, 95% CI [0.402, 1.412]) indicates that, holding infrastructure constant, each one-unit increase in managerial competence score is associated with a 0.907-unit increase in teacher motivation. The standardized coefficient ($\beta = 0.881$) reflects the dominant relative contribution of X1. The coefficient for X2 (B = –0.162, SE = 0.309, t = –0.524, p = .607, 95% CI [–0.814, 0.490]) was not statistically significant when controlling for X1; because this interval spans zero and extends to a magnitude comparable to X1’s coefficient in absolute terms, the data are also compatible with a small positive or negative true partial association, and the finding should be read as inconclusive at this sample size rather than as evidence that infrastructure has no independent relationship with motivation. The 95% confidence intervals

reported here were computed analytically from the classical multiple-regression formula using the already-reported n , standard deviations, tolerance/VIF, and residual mean square ($MSE = 12.761$) and are conventional OLS intervals; they assume homoscedastic, independent errors and do not correct for the non-normal residuals noted in Table 4, so bootstrap or heteroscedasticity-consistent (HC3) intervals, which require the case-level dataset, remain the preferred estimate for a future revision. Partial association testing results: H1 Supported ($p = .001$); H2 Not Supported ($p = .607$).

Table 7. Model Summary and Simultaneous Significance Test (F-test)

Statistic	Value	Interpretation
F	18.488	Significant
df (regression / residual)	2 / 17	
Sig. (p)	< .001	H3 Supported
R ² (Coefficient of Determination)	0.685	68.5% variance explained
Adjusted R ²	0.648	After adjusting for model complexity

Note: $F(2,17) = 18.488$, $p < .001$. The model containing managerial competence and infrastructure is statistically significant overall (H3 Supported); this omnibus result indicates that the model explains significantly more variance than an intercept-only model, but it does not by itself establish that both predictors make significant individual contributions — the model-level result was primarily attributable to managerial competence, as only its partial coefficient was statistically significant (Table 6). $R^2 = .685$ indicates that 68.5% of the variance in teacher motivation is jointly explained by the model. The Adjusted $R^2 = .648$ accounts for model parsimony.

Discussion

The findings of this study indicate that teachers' perceived principal managerial competence has a significant positive partial association with teachers' work motivation (H1 Supported), while perceived school infrastructure does not exhibit a significant independent partial association (H2 Not Supported), and the model containing both predictors was statistically significant overall (H3 Supported), although this model-level result was primarily attributable to managerial competence rather than to a significant independent contribution from infrastructure. These results partially confirm the study's hypotheses and provide a theoretically nuanced picture of the organizational determinants of teacher motivation in vocational schools.

The significant positive partial association of perceived managerial competence with teacher motivation ($B = 0.907$, $p = .001$, $\beta = 0.881$) aligns with a robust body of evidence indicating that principal leadership quality is among the strongest organizational predictors of teacher motivation. Azainil et al. (2021) demonstrated that principals serve as a central driver of productivity through effective resource management and consistent performance-oriented practices; Rachmawati and Suyatno (2021) similarly found that principals' competencies significantly predicted teachers' job satisfaction and work commitment in Indonesian junior-secondary schools; and Muttaqin et al. (2023) demonstrated in a large Indonesian sample that managerial competence influences teacher outcomes partly through the mediating role of commitment. In the specific vocational education context, where principals must coordinate theory–practice integration, schedule practicum sessions across multiple workshops, and maintain industry partnerships, the planning, organizing, actuating, and controlling functions articulated by Terry (as cited in Siagian, 2018) and codified in Permendiknas No. 13/2007 appear particularly salient in maintaining teachers' enthusiasm. The very high standardized coefficient

($\beta = 0.881$) indicates that managerial competence was the strongest statistical predictor of teacher motivation within this school sample; given $n = 20$, predictor overlap with infrastructure, a restricted score range, and the shared self-report source of all three variables, this coefficient should be regarded as imprecisely estimated rather than as a stable population parameter.

The non-significant partial regression coefficient for infrastructure ($B = -0.162$, $p = .607$, $\beta = -0.122$) warrants careful interpretation rather than a simple conclusion that infrastructure is irrelevant to teacher motivation. Several tentative, non-mutually-exclusive explanations are offered, none of which was directly tested in this study. First, the strong bivariate Spearman correlation ($r_s = .821$, $p < .001$) shows that infrastructure is meaningfully associated with teacher motivation when examined in isolation; this bivariate association is reported descriptively and does not confirm or corroborate the partial-regression model, since Spearman correlations do not estimate the unique contribution of a predictor after controlling for another. The non-significant partial coefficient emerges specifically once managerial competence is held constant, which is consistent with, though not formal proof of, shared variance between X_1 and X_2 ($r_s = .833$; $VIF = 3.274$) producing an unstable partial estimate for X_2 rather than a confirmed suppression mechanism: because principals with higher managerial competence also tend to be perceived as managing infrastructure more effectively, much of the variance attributable to X_2 overlaps with X_1 , leaving little unique variance for X_2 to explain once X_1 is partialled out. Second, this pattern is broadly compatible with Herzberg's Two-Factor Theory (Herzberg et al., 1959), which would characterize infrastructure as a hygiene factor that prevents dissatisfaction rather than directly generating motivation, while managerial competence draws on motivator-associated elements such as recognition, goal-setting, and performance feedback; however, this study did not measure dissatisfaction, motivational thresholds, or mediation, so the Herzberg-based explanation should be treated as a plausible interpretation rather than a confirmed mechanism. Because 80% of respondents rated infrastructure in the highest category (very good), a potential ceiling effect rather than a floor effect may further limit infrastructure's capacity to differentiate motivation levels across respondents; the degree of score clustering was not formally tested, and this explanation should likewise be treated as tentative.

Third, Toropova et al. (2021) similarly found that working-condition-related factors, while significantly associated with teacher satisfaction bivariate, were often less dominant than leadership and professional-development factors in multivariate models. Mustafa et al. (2022) also reported that hygiene factors in Malaysian vocational college teachers ceased to act as primary motivators once they reached a perceived adequacy threshold. This qualification is worth noting because infrastructure and motivation are not always independent in the wider literature: Saputra et al. (2026) found that both facility conditions and teacher motivation directly and jointly predicted teacher professionalism in an Indonesian secondary-school sample, which is a reminder that the non-significant partial coefficient for X_2 observed here is more plausibly a feature of this small, collinear, single-school sample than evidence that infrastructure is generally unrelated to motivation. Fourth, this pattern echoes recent international evidence: Mussa and Boniface (2025) found that Tanzanian secondary teachers themselves characterized salary and material conditions as hygiene rather than motivational factors, and Piele, Ionașcu, Pânișoară, and Lazăr (2026) demonstrated that supportive infrastructure predicts teacher resilience primarily indirectly, through its association with intrinsic motivation, rather than through a direct main effect—a pattern broadly compatible with the shared-variance dynamic observed for X_2 in the present study.

The simultaneous regression model was statistically significant, $F(2, 17) = 18.488$, $p < .001$, with $R^2 = .685$, indicating that managerial competence and infrastructure together explain 68.5% of the variance in teacher motivation. This joint explanatory power—though driven primarily by X1 underscores the importance of considering both leadership and facility dimensions in organizational analyses of teacher motivation. The remaining 31.5% of variance attributable to other factors is consistent with Sahito et al.'s (2025) recent synthesis identifying teacher motivation as a multifactorial construct shaped by organizational, psychological, and contextual variables including compensation, school culture, peer collegiality, and professional identity. Two methodological caveats should also be acknowledged. First, the non-normal residual distribution (Shapiro–Wilk $W = .895$, $p = .033$) means that the ordinary-least-squares standard errors, t-values, and p-values reported in Table 6 should be interpreted with caution; the supplementary Spearman correlations, which are assumption-free, describe the direction and significance of the bivariate associations but do not correct the regression standard errors or confirm the partial-regression estimates, and are therefore reported as descriptive rather than corroborating evidence. Second, because managerial competence, infrastructure, and motivation were all rated by the same 20 teachers using structurally similar self-report scales within the same period, the observed associations may be partly inflated by common-method variance, response-style tendencies, or a generalized halo of positive perception toward the school; this same-source limitation is discussed further below.

Limitation

Several limitations of this study should be acknowledged. First, because all 20 teachers employed at SMK Negeri 2 Rupert were surveyed as a school-level census, the findings should be treated as an exploratory, single-site pattern rather than a probability-based sample that generalizes to other SMK with differing institutional, geographic, or resource characteristics; based on Green's (1991) rule of thumb ($N \geq 50 + 8k$), a minimum of 66 respondents would in any case be recommended for a two-predictor regression intended for external inference. Second, the cross-sectional associative design does not permit causal inference; the observed relationships should be interpreted strictly as statistical associations. Third, non-normal data distributions for all variables and residuals (Shapiro–Wilk $p < .05$) constitute a violation of ordinary-least-squares assumptions; the regression estimates in Table 6 are therefore best regarded as approximate, and the study did not re-estimate uncertainty using bootstrap confidence intervals, heteroscedasticity-consistent (e.g., HC3) standard errors, or permutation-based regression, any of which would be more appropriate than conventional OLS inference at this sample size. Conventional 95% confidence intervals (X1: [0.402, 1.412]; X2: [−0.814, 0.490]) have been added to the Results using the classical formula and the already-reported MSE and Tolerance values; these intervals do not, however, correct for the non-normal residuals, and re-estimating them using bootstrap, HC3, or permutation-based methods on the raw dataset remains a priority for the next revision. A previously reported post-hoc power estimate ($f^2 = 2.175$, power ≈ 1.00) has been removed from this limitation, as observed power is driven largely by the obtained p-value and does not itself resolve concerns about small-sample instability.

Fourth, while the Glejser test indicated no significant heteroscedasticity associated with either predictor (X1: $p = .331$; X2: $p = .601$), the analysis did not examine influential observations, leverage, Cook's distance, or studentized residuals; with only 20 respondents, one or two cases could materially affect the reported coefficients, and inspecting and reporting these diagnostics together with a sensitivity analysis excluding any highly influential cases is identified as a priority for the next revision. Fifth, the moderate collinearity between X1 and X2 ($VIF = 3.274$; $rs = .833$) inflates standard errors by a factor of approximately 1.81 and may explain the non-significant partial coefficient for X2, making it difficult to cleanly separate the independent contributions of

managerial leadership and infrastructure. Sixth, all three constructs were measured via self-report from the same 20 teachers within the same period using structurally similar Likert instruments; the resulting common-method variance, together with possible social-desirability bias, may inflate the observed associations, and future studies should triangulate teacher self-reports with objective infrastructure audits, administrative records, classroom observation, or ratings from additional respondent groups. Seventh, validity evidence for the three instruments was limited to corrected item-total correlations and Cronbach's alpha; these procedures do not establish dimensionality or construct validity, factor analysis was not feasible at $n = 20$, and the description of the questionnaires as "validated" in earlier drafts has accordingly been qualified throughout this manuscript. Future research is encouraged to use larger, multi-site probability samples; apply robust or bootstrap regression methods with influential-case diagnostics; pursue formal construct-validation procedures; explore mediating variables (e.g., school culture, teacher commitment, compensation); and incorporate longitudinal or mixed-methods designs.

Research Implications

Theoretically, this study extends the literature on educational leadership and facility management into the comparatively underexplored vocational education context. By documenting that principals' managerial competence was the dominant partial statistical predictor while infrastructure's independent contribution diminished once managerial competence was accounted for a pattern tentatively compatible with both Herzberg's Two-Factor Theory and shared-variance-driven instability in the partial estimate for infrastructure in this multivariate model the study offers a preliminary, single-site illustration relevant to the dual-factor framework in SMK settings, to be tested more rigorously in larger, multi-site samples. Practically, the findings carry two preliminary implications specific to this school context. First, within SMK Negeri 2 Rupert, continuous development of principals' managerial competence—through structured leadership-training programmes, peer mentoring between principals, and performance-based evaluation—appears to be an important lever for sustaining teacher motivation, broadly consistent with Sariakin et al.'s (2025) finding that leadership quality and management practices jointly foster a more productive educational environment; whether this generalizes to other vocational schools would need to be confirmed in future multi-site research before informing district- or national-level policy. Second, while infrastructure alone did not independently predict motivation in this context where facilities were already perceived as adequate, maintaining and improving practical-learning facilities plausibly remains important for preventing dissatisfaction and supporting the conditions under which managerial leadership can be effective. Resource allocation decisions at the school and district level may accordingly wish to balance investment in both leadership capacity and facility quality, pending confirmation from larger-scale research.

CONCLUSIONS

This study examined the partial and simultaneous statistical associations of teachers' perceptions of principal managerial competence and school infrastructure with teachers' self-reported work motivation at SMK Negeri 2 Rupert. Partial analysis revealed that perceived managerial competence was significantly and positively associated with teacher motivation ($B = 0.907$, $p = .001$, H1 Supported), whereas perceived school infrastructure showed no significant independent partial association ($B = -0.162$, $p = .607$, H2 Not Supported)—a pattern that may be related to shared variance between the two predictors ($VIF = 3.274$) and, tentatively, to the hygiene-factor role that Herzberg's framework assigns to working-condition variables such as infrastructure, although coefficient instability at $n = 20$ cannot be ruled out. The model containing managerial competence and infrastructure was statistically significant overall, $F(2, 17) = 18.488$, $p < .001$, $R^2 = .685$ (H3 Supported), although this model-level result was primarily attributable to managerial competence, since only its partial coefficient was statistically significant.

Supplementary Spearman correlations indicated strong bivariate associations for both X1–Y ($r_s = .904$) and X2–Y ($r_s = .821$); these bivariate results are reported as descriptive, assumption-free evidence and do not corroborate or substitute for the partial-regression estimates, which alone address the unique contribution of each predictor. Within SMK Negeri 2 Rupert, perceived managerial competence was the stronger statistical predictor of teacher motivation, and the non-significance of the infrastructure coefficient reflects estimation imprecision at $n = 20$ rather than proof that infrastructure is unrelated to motivation. Given the cross-sectional, single-school, non-probability design, these findings should be read as an exploratory case-specific pattern; they do not establish a causal relationship, and they should not be generalized to Indonesian vocational schooling as a whole or treated as a policy foundation without further replication in larger, multi-site samples.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to the principal, teachers, and administrative staff of SMK Negeri 2 Rupert, Bengkalis Regency, for their permission, cooperation, and active participation throughout the data collection process. Appreciation is also extended to Universitas Negeri Yogyakarta for the academic guidance and supervisory support provided during the preparation of this manuscript.

AUTHOR CONTRIBUTION STATEMENT

MN contributed to the conceptualization of the study, research design, data collection, statistical analysis, and initial manuscript drafting. YA contributed to the supervision of the research process, methodological validation, interpretation of findings, critical revision of the manuscript, and final approval of the submitted version. Both authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

AI DISCLOSURE STATEMENT

The authors declare that AI-assisted tools were used solely to support English translation, language refinement, and structural reformatting of this manuscript. All research data and statistical results presented in this manuscript were derived from the original SPSS-processed dataset. The standard errors, t-values, and 95% confidence intervals in Table 6 and the accompanying text were computed analytically using the classical multiple-regression formula $SE(B_j) = \sqrt{[MSE / (SS_j \times \text{Tolerance}_j)]}$, drawing only on statistics already reported elsewhere in this manuscript (n , standard deviations, VIF/Tolerance, and MSE); this derivation reproduces the previously reported SE and t values to the third decimal place and is disclosed in the Table 6 footnote. Standardized coefficients were computed as $\beta = B \times (SD_x/SD_y)$, the standard OLS relationship between unstandardized and standardized coefficients. All intellectual content, data interpretation, methodological decisions, and scholarly judgments remain the sole responsibility of the authors.

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