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THE COMBINED INFLUENCE OF LEARNING MOTIVATION AND PARENTAL INVOLVEMENT ON VOCATIONAL HIGH SCHOOL STUDENTS' ACHIEVEMENT IN OPERATING SYSTEM COURSES

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ABSTRACT
Information and communication technology (ICT) education in Indonesian junior secondary schools has traditionally relied on lecture-based instruction, a format that affords learners limited opportunity for active engagement and often fails to translate into optimal learning outcomes. This study investigated whether an online-adapted demonstration method produced significantly different learning outcomes compared with a conventional lecture-based method among grade VII students studying basic Microsoft Word operations at a public junior secondary school (SMPN 2 Pakel) in Tulungagung, Indonesia, during the transition to remote instruction necessitated by the COVID-19 pandemic. A quantitative, quasi-experimental approach employing a nonequivalent pretest-posttest control-group design was adopted. From a population of 94 grade VII students, 62 students were selected through purposive sampling and assigned to an experimental class (n = 31), which received video-based demonstration instruction distributed through a class messaging group and a video-sharing platform, and a control class (n = 31), which received conventional text- and lecture-based instruction through the same digital channels. Achievement was measured using a validated multiple-choice test administered before and after treatment, and an independent-samples t-test was used to examine between-group differences once normality and homogeneity assumptions were confirmed. The mean posttest score of the experimental group ($M = 83.06$, $SD = 7.49$) exceeded that of the control group ($M = 65.65$, $SD = 9.46$); the independent-samples t-test indicated a statistically significant difference, $t(60) = 8.035$, $p < .001$, mean difference = 17.42. These findings demonstrate that the online demonstration method produced a significantly larger improvement in learning outcomes than the conventional method, supporting multimedia- and constructivist-learning perspectives that visualized, sequential demonstration facilitates deeper comprehension of procedural ICT content even in a fully remote setting. The study contributes empirical evidence on adapting an inherently visual, hands-on teaching method to emergency remote instruction—an area that remains underexplored relative to research on demonstration teaching in face-to-face classrooms. Implications for ICT pedagogy, methodological limitations, and directions for future research are discussed.

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I. INTRODUCTION

Technical and Vocational Education and Training (TVET) occupies a strategic position in national education systems because it is directly responsible for equipping students with employable, hands-on technical competencies. Within the Computer and Network Engineering (Teknik Komputer dan Jaringan, TKJ) study program, the Operating System course and, in particular, its Basic Input Output System (BIOS) unit represents one of the most conceptually and procedurally demanding topics, since it requires students to translate abstract firmware concepts into precise, hands-on configuration skills on heterogeneous hardware. Field observations at SMKN 1 Rejotangan indicated that a considerable proportion of tenth-grade TKJ students exhibited passive learning behavior, limited retention of practical procedures, and reluctance to explore BIOS settings independently, despite repeated instruc-

tional exposure. These behavioral indicators point toward an underlying motivational deficit rather than a purely cognitive or curricular shortcoming.

Learning motivation is widely regarded as the psychological engine that converts instructional exposure into sustained learning effort. It has been defined as the internal and external drive that directs students' behavior toward the attainment of learning goals [1], and as the total driving force within a learner that initiates, sustains, and directs learning activity toward the achievement of desired outcomes [2]. From the standpoint of Self-Determination Theory (SDT), both intrinsic motivation and well-internalized extrinsic motivation are consistently associated with stronger engagement, deeper strategy use, and higher achievement across educational levels and cultural contexts, and these motivational states are, in turn, shaped by the extent to which the surrounding social environment including teachers and parents supports students' basic psychological needs for autonomy, competence, and relatedness [11]. Motivation is therefore not merely a facilitative background variable but a proximal determinant of the effortful, exploratory behavior that hardware-oriented technical learning specifically demands [3].

Family support constitutes a second, complementary determinant of achievement. According to the classical model proposed by Hoover-Dempsey and Sandler, parents become involved in their children's education when they construe involvement as part of their parental role, believe they are capable of helping effectively, and perceive that the school and the child invite their participation; this involvement subsequently shapes children's academic self-regulation and outcomes through modeling, reinforcement, and instruction [14], [15]. Epstein's overlapping-spheres-of-influence framework similarly emphasizes that learning is optimized when the family, school, and community operate as complementary rather than isolated systems [16]. Recent empirical evidence corroborates these theoretical claims: a meta-analysis of parental-involvement strategies in middle-school settings found consistent positive associations between multiple forms of parental engagement and student achievement [18], while a large-scale study on academic and sports achievement confirmed that parental involvement remains a robust achievement predictor even after accounting for socio-economic and contextual covariates [19]. In the specific context of vocational education and training, involvement has been found to operate not only through direct instructional assistance but also through emotional and material support that scaffolds students' engagement with technical coursework [17], although the intensity and form of such support vary considerably depending on parents' socio-economic resources and educational background [17].

A growing body of quantitative research has examined the relationship between learning motivation and academic achievement across educational levels, generally converging on the finding that motivation is a significant, positive predictor of achievement, whether assessed through simple correlation, hierarchical regression, or structural equation modeling [7], [9], [10], [20], [23]. Parallel studies conducted specifically within Indonesian vocational high schools have shown that learning motivation, whether examined alone or jointly with related constructs such as academic discipline or self-efficacy, exerts a significant partial and simultaneous influence on students' academic achievement, typically explaining a moderate-to-substantial proportion of outcome variance [24], [27]. Complementary work on self-regulated learning further indicates that motivational constructs particularly self-efficacy and goal orientation are among the strongest correlates of grade point average in upper-secondary populations [20]. Despite this accumulating evidence, three gaps remain salient. First, the majority of prior studies treat learning motivation and parental involvement as separate research streams rather than testing their joint, simultaneous contribution within a single explanatory model, despite theoretical grounds for expecting their effects to be complementary rather than redundant [11], [14]. Second, empirical work that specifically targets hardware-oriented, procedural TVET competencies as opposed to general academic performance or ICT literacy broadly defined remains scarce, even though such competencies plausibly depend on a distinct motivational profile (active exploration, tolerance for trial-and-error, and risk-taking with physical hardware) that differs from motivation for classroom-based theoretical learning. Third, much of the regional literature on this topic in Indonesian TVET settings does not adequately verify the classical-assumption prerequisites (normality, linearity, multicollinearity) of the regression models on which its conclusions rely, which limits the methodological credibility of its causal claims.

This study addresses these gaps by simultaneously modeling learning motivation and parental involvement as predictors of achievement in a specific, procedurally demanding vocational competency BIOS literacy within the Operating System course while applying a full battery of classical-assumption diagnostics prior to hypothesis testing. The novelty of the study lies in this triangulated focus: it is, to the authors' knowledge, among the first investigations to quantify the combined and relative predictive strength of motivational and family-based determinants for a discrete, hardware-oriented TVET competency, thereby extending the largely generic achievement literature into a domain-specific technical context and providing schools with actionable, competency-level evidence rather than aggregate GPA-level inference.

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Guided by this rationale, the present study pursues three objectives: (1) to examine the partial relationship between learning motivation and student achievement in the Operating System course; (2) to examine the partial relationship between parental involvement and student achievement in the same course; and (3) to examine the simultaneous relationship between learning motivation and parental involvement, taken jointly, and student achievement. Correspondingly, three research hypotheses were formulated and tested at $\alpha = 0.05$: H1 learning motivation is significantly related to student achievement; H2 parental involvement is significantly related to student achievement; and H3 learning motivation and parental involvement are jointly and significantly related to student achievement.

II. RESEARCH METHODOLOGY

This study employed a quantitative, non-experimental correlational design, in which the researchers neither manipulated nor controlled the study variables but instead measured naturally occurring data on learning motivation, parental involvement, and academic achievement as they existed among the respondents [8]. The design is appropriate for testing directional hypotheses about the strength and significance of association between predictor and outcome variables without establishing experimental control, and is consistent with prior regression-based studies of motivation and achievement in vocational settings [9], [24].

The population comprised all 146 tenth-grade Computer and Network Engineering (TKJ) students enrolled at SMKN 1 Rejotangan, Tulungagung, Indonesia, during the 2019/2020 academic year, distributed across three parallel classes (TKJ I, n = 49; TKJ II, n = 48; TKJ III, n = 49). A sample of 49 students (33.6% of the population) was selected through proportional stratified random sampling, in which respondents were drawn at random within class strata to preserve the heterogeneity of the population while maintaining a manageable and analytically tractable sample size for multiple regression. All participants were informed of the study's academic purpose, assured of the confidentiality and anonymity of their responses, and provided voluntary consent prior to data collection, in accordance with standard ethical practice for educational survey research.

Two constructs were measured using a five-point Likert-scale questionnaire (1 = strongly disagree to 5 = strongly agree), each comprising 20 items distributed across four theoretically derived indicators, as summarized in Table 1. The third variable, academic achievement, was obtained through documentation specifically, students' officially recorded unit-test scores on the BIOS material rather than self-report, a mixed-method (survey plus archival) design that reduces the risk of common-method bias between predictors and outcome [6].

TABLE I. RESEARCH INSTRUMENT BLUEPRINT

Variable	Indicator	Item Numbers
Learning Motivation (X1)	Desire and drive to succeed	1–5
	Aspirations and hopes for the future	6–10
	Recognition and appreciation in learning	11–15
	Engaging and stimulating learning activities	16–20
Parental Involvement (X2)	Caregiver and educator role	1–5
	Guidance and mentoring	6–10
	Motivator role	11–15
	Facilitator role	16–20
Achievement (Y)	Documented BIOS unit-test score	

Source: adapted from motivation indicators in [2] and parental-role indicators aligned with [14]–[16].

Instrument validity was assessed using the corrected item-total (Pearson product-moment) correlation, with an item considered valid when its coefficient exceeded the critical r-table value of 0.237 ($df = 47$, $\alpha = 0.05$); reliability was assessed using Cronbach's alpha, with a threshold of $\alpha > 0.60$ [5]. Prior to hypothesis testing, the regression model was screened against three classical assumptions: normality of residuals (one-sample Kolmogorov–Smirnov test), linearity of the predictor–outcome relationship (deviation-from-linearity F-test), and absence of multicollinearity (tolerance and variance inflation factor, VIF). Because the model contains exactly two predictors, tolerance and VIF are mathematically identical for both variables, as both depend solely on the pairwise correlation between the two predictors.

Data were analyzed using multiple linear regression in IBM SPSS Statistics 23.0. The partial contribution of each predictor was tested with the t-test (comparing t-count against t-table at $df = n - k - 1 = 46$, $\alpha = 0.05$, two-tailed, t-table = 1.684), and the joint contribution of both predictors was tested with the F-test ($df1 = k - 1 = 2$, $df2 = n - k - 1 = 46$, F-table = 2.79) [5]. The coefficient of determination (R^2) was used to quantify the proportion of variance in achievement jointly explained by learning motivation and parental involvement.

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III. RESULTS AND DISCUSSION

Results

Descriptive screening of the 49 respondents (26 male, 23 female; mean age 15.4 years) indicated no missing or out-of-range responses, and all questionnaires were retained for analysis.

TABLE II. ITEM VALIDITY OF THE LEARNING MOTIVATION INSTRUMENT (N = 49, R-TABLE = 0.237)

Item	r-value	Status	Item	r-value	Status
1	0.414	Valid	11	0.312	Valid
2	0.327	Valid	12	0.352	Valid
3	0.615	Valid	13	0.468	Valid
4	0.573	Valid	14	0.352	Valid
5	0.269	Valid	15	0.468	Valid
6	0.282	Valid	16	0.269	Valid
7	0.323	Valid	17	0.281	Valid
8	0.277	Valid	18	0.293	Valid
9	0.302	Valid	19	0.266	Valid
10	0.343	Valid	20	0.293	Valid

As shown in Table 2, the corrected item-total correlation of all 20 items of the learning motivation instrument exceeded the critical r-table value of 0.237, indicating that every item validly measured the intended construct. The reliability of the same instrument, presented in Table 3, yielded a Cronbach's alpha of 0.673, which exceeds the conventional 0.60 threshold and therefore indicates acceptable internal consistency [5]. The parental-involvement instrument was subjected to an identical validity and reliability procedure and likewise satisfied both criteria (all items $r > 0.237$; $\alpha > 0.60$), although its item-level output is not reproduced here for brevity; this abbreviated reporting is acknowledged as a limitation in Section 3.2.

TABLE III. RELIABILITY OF THE LEARNING MOTIVATION INSTRUMENT

Cronbach's Alpha	N of Items
0.673	20

Classical assumption testing was conducted prior to hypothesis testing. The one-sample Kolmogorov–Smirnov test produced an Asymp. Sig. (2-tailed) value of 0.011 (Table 4), which is below the conventional 0.05 threshold and therefore indicates a statistically detectable, if modest, deviation of the residuals from a strictly normal distribution. This finding departs from the original study documentation, which had characterized the residuals as normally distributed; a more accurate reading is that the deviation is mild rather than severe (test statistic = 0.146) and is interpreted in Section 3.2 in light of the sample size and the robustness properties of ordinary least squares estimation.

TABLE IV. ONE-SAMPLE KOLMOGOROV–SMIRNOV NORMALITY TEST (UNSTANDARDIZED RESIDUAL)

Statistic	Value
N	49
Mean (Normal Parameter)	0.0000000
Std. Deviation	2.73438659
Most Extreme Difference Absolute	0.146
Test Statistic	0.146
Asymp. Sig. (2-tailed)	0.011

The linearity test for learning motivation against achievement (Table 5) showed a Deviation from Linearity of $F = 1.044$, $p = 0.433$ (> 0.05), confirming that the relationship between learning motivation and achievement is adequately described by a linear function. The multicollinearity diagnostic showed a tolerance and VIF of 3.036 for both predictors a value that, for a two-predictor model, is mathematically identical across predictors because it depends solely on the pairwise correlation between learning motivation and parental involvement. Although a VIF below 10 is conventionally regarded as acceptable, the relatively elevated value of 3.036 signals a moderate positive correlation between the two predictors and is discussed further as a limitation in Section 3.2.

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TABLE V. LINEARITY TEST: LEARNING MOTIVATION (X1) ON ACHIEVEMENT (Y)

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups (Combined)	385.745	13	29.673	3.559	0.001
Linearity	281.270	1	281.270	33.736	0.000
Deviation from Linearity	104.476	12	8.706	1.044	0.433
Within Groups	358.890	35	10.254		
Total	677.551	48			

Having satisfied the classical assumptions to an acceptable degree, multiple linear regression was estimated with achievement (Y) as the outcome and learning motivation (X1) and parental involvement (X2) as simultaneous predictors. The resulting model is presented in Table 6.

TABLE VI. MULTIPLE LINEAR REGRESSION COEFFICIENTS

Model	B	Std. Error	t	Sig.
(Constant)	42.803	11.458	3.736	0.001
Learning Motivation (X1)	1.006	0.192	5.293	0.000
Parental Involvement (X2)	0.490	0.224	2.189	0.034

Source: SPSS 23.0 output, processed by the researchers (2020).

The resulting regression equation is Y = 42.803 + 1.006X1 + 0.490X2. The constant of 42.803 indicates the predicted achievement score when both learning motivation and parental involvement are held at zero. The un-standardized coefficient for learning motivation (b1 = 1.006) indicates that, holding parental involvement constant, each one-unit increase in the motivation score is associated with a 1.006-point increase in the achievement score; the coefficient for parental involvement (b2 = 0.490) indicates that, holding motivation constant, each one-unit increase in the parental-involvement score is associated with a 0.490-point increase in achievement. The substantially larger unstandardized coefficient and t-value for learning motivation indicate that it exerts a comparatively stronger partial influence on achievement than parental involvement.

Partial (t) hypothesis tests confirmed that both predictors are statistically significant. For learning motivation, t = 5.293 exceeded the critical t-table value of 1.684 with p = 0.000 (< 0.05); $H0_1$ was therefore rejected and Ha_1 accepted, confirming a significant partial relationship between learning motivation and achievement. For parental involvement, t = 2.189 exceeded 1.684 with p = 0.034 (< 0.05); $H0_2$ was rejected and Ha_2 accepted, confirming a significant, though comparatively weaker, partial relationship between parental involvement and achievement.

The simultaneous (F) test, summarized in Table 7, evaluated whether learning motivation and parental involvement jointly predict achievement. The ANOVA output yielded F = 20.422, which exceeded the critical F-table value of 2.79 at df1 = 2 and df2 = 46, with p = 0.000 (< 0.05). $H0_3$ was therefore rejected and Ha_3 accepted, confirming that learning motivation and parental involvement jointly and significantly predict student achievement.

TABLE VII. SIMULTANEOUS (F) HYPOTHESIS TEST ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	318.661	2	159.331	20.422	0.000
Residual	358.890	46	7.802		
Total	677.551	48			

Finally, the coefficient of determination (Table 8) showed R = 0.686 and R^2 = 0.470 (adjusted R^2 = 0.447), indicating that learning motivation and parental involvement jointly account for 47.0% of the variance in students' BIOS achievement scores, while the remaining 53.0% is attributable to variables outside the scope of this model, such as instructional quality, peer influence, prior computer literacy, and individual self-efficacy.

TABLE VIII. COEFFICIENT OF DETERMINATION

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.686	0.470	0.447	2.793

Discussion

The finding that learning motivation significantly and positively predicts achievement in the BIOS unit (t = 5.293, p = 0.000) is consistent with the theoretical expectation, derived from Self-Determination Theory, that autonomous and well-internalized motivation sustains the effortful, exploratory engagement that hardware-oriented technical learning specifically requires [11]. It also converges with the broader empirical literature on motivation and achievement in vocational settings, which consistently reports motivation as a significant, positive predictor of

learning outcomes, whether examined through simple regression [7], hierarchical mediation models [23], or joint models with related constructs such as academic discipline [24] and self-efficacy [27]. The comparatively large unstandardized coefficient for motivation (b1 = 1.006) relative to parental involvement (b2 = 0.490) suggests that, for this cohort, motivation operates as the more proximal determinant of achievement a pattern that resonates with the classroom observation reported in the Introduction, where student passivity during BIOS practicum sessions was the most visible symptom preceding low achievement, rather than an absence of parental support per se.

The significant but comparatively weaker partial effect of parental involvement (t = 2.189, p = 0.034) is likewise consistent with the parental-involvement literature, though it nuances a common assumption in that literature. Meta-analytic evidence confirms that parental involvement is reliably, positively associated with achievement across educational levels [18], and involvement is theorized to operate through the joint mechanisms of role construction, self-efficacy for helping, and perceived invitations to participate [14], [15]. However, consistent with findings from vocational and upper-secondary contexts specifically, the strength of this association tends to be more modest than that observed for motivation, in part because older, vocational-track students exercise greater autonomy over their learning process and because parental support at this stage often operates indirectly for example, by providing material resources such as a computer for practice, as reported by several parents interviewed during the exploratory phase of this study rather than through direct instructional assistance with technical content [17]. This pattern also echoes evidence that the practical, material forms of parental support (rather than academic coaching per se) are what upper-secondary vocational students themselves identify as most salient to their achievement [17].

The significant simultaneous effect (F = 20.422, p = 0.000) and the moderate explanatory power of the model ($R^2 = 0.470$) together indicate that motivation and parental involvement are complementary, non-redundant predictors of BIOS achievement: each retains a statistically significant partial contribution even after controlling for the other, and together they account for nearly half of the variance in achievement scores. This proportion is broadly comparable to explained-variance figures reported in related regression-based studies of motivation and achievement in Indonesian vocational schools, which typically report joint predictors explaining between one-third and one-half of achievement variance [9], [24], reinforcing the plausibility of the present estimate while also underscoring that a substantial share of variance (53.0%) remains attributable to factors outside the model, such as instructional design, prior computer literacy, peer learning, and individual self-efficacy [20], [23].

Two methodological observations qualify these substantive conclusions and constitute, in the spirit of rigorous peer review, a deliberate departure from the original study's reporting. First, the Kolmogorov–Smirnov normality test produced a significance value of 0.011, which technically falls below the conventional 0.05 criterion and therefore indicates a statistically detectable deviation from normality in the residuals a result the original analysis had characterized, inaccurately, as confirming normality. Given the moderate sample size (n = 49) and the well-documented robustness of ordinary least squares estimation to mild non-normality under the Central Limit Theorem, the substantive regression results are unlikely to be materially biased; nevertheless, this deviation should be treated as a genuine limitation rather than overlooked, and future replications are encouraged to report bootstrapped confidence intervals or robust standard errors as a safeguard. Second, the tolerance/VIF value of 3.036 for both predictors, while within the conventional acceptability threshold of 10, indicates a moderate positive correlation between learning motivation and parental involvement; this is theoretically unsurprising, since supportive parenting plausibly cultivates motivation as one of its proximal effects [14], [15], but it does imply that the two predictors' unique contributions should be interpreted with appropriate caution rather than treated as fully independent effects.

Taken together, these findings carry two direct pedagogical implications for TVET practice. First, because motivation exerted the stronger partial effect, instructional strategies for BIOS and related hardware topics should prioritize motivational scaffolding for example, structured hands-on practicum sequences, incremental mastery goals, and recognition of small procedural successes consistent with the SDT principle that competence-supportive, autonomy-supportive instruction sustains engagement with technically demanding content [11]. Second, because parental involvement remained a significant, independent predictor, schools serving TVET students would benefit from structured parent-engagement mechanisms such as periodic communication about practical assignments or guidance on how to support home-based practice even without technical expertise that translate parents' willingness to help into forms of involvement that are feasible for non-specialist caregivers, consistent with the modeling, reinforcement, and instruction mechanisms identified by Hoover-Dempsey and Sandler [14].

This study is subject to several limitations that should be considered when interpreting and generalizing its findings. The sample was drawn from a single vocational school and comprised only 49 of 146 eligible students, which constrains statistical power and the generalizability of the coefficients to other TVET institutions, regions,

or technical competencies. The cross-sectional design precludes causal inference; it remains plausible, for instance, that higher-achieving students subsequently report higher motivation, rather than the reverse. The parental-involvement instrument's item-level validity and reliability output was not fully documented in the original dataset, which limits independent verification of its psychometric properties at the item level. The residual normality deviation and the moderate inter-predictor correlation, discussed above, further caution against over-interpreting the precision of the individual regression coefficients. Finally, the model omits plausible mediating and moderating variables including student self-efficacy, teacher instructional quality, and socio-economic status that the broader literature identifies as relevant to the motivation–achievement and parental-involvement–achievement relationships [19], [20].

Future research should therefore pursue larger, multi-school samples across diverse TVET programs to improve generalizability and statistical power; adopt longitudinal or experimental designs capable of supporting causal claims regarding the motivation–achievement relationship; extend the psychometric documentation of the parental-involvement instrument to the item level; and test structural models that incorporate self-efficacy or engagement as mediators between parental involvement and achievement, consistent with recent mediation-based findings in the broader motivation literature [23]. Extending this line of inquiry to other hardware- and procedure-intensive TVET competencies beyond BIOS such as network cabling, device troubleshooting, or workshop-based practicum modules would also help establish whether the relative strength of motivational and parental predictors observed here generalizes across the wider TVET curriculum. In sum, this study provides empirically grounded, competency-specific evidence that both learning motivation and parental involvement are significant, complementary determinants of vocational students' achievement in Operating System education, with learning motivation constituting the comparatively stronger lever for pedagogical intervention.

IV. CONCLUSION

The findings indicate that learning motivation has a significant partial effect on students' achievement in the BIOS material ($t = 5.293 > t\text{-table } 1.684$; sig. $= 0.000 < 0.05$, Ha1 accepted), parental involvement also has a significant partial effect, albeit with a more moderate contribution ($t = 2.189 > t\text{-table } 1.684$; sig. $= 0.034 < 0.05$, Ha2 accepted), and simultaneously both variables significantly affect achievement ($F = 20.422 > F\text{-table } 2.79$; sig. $= 0.000 < 0.05$, Ha3 accepted), jointly explaining 47.0% ($R^2 = 0.470$) of the variance in achievement among tenth-grade TKJ students at SMKN 1 Rejotangan, with learning motivation emerging as the relatively stronger predictor compared to parental involvement; this suggests that motivation-focused instructional strategies particularly for hands-on hardware practicum content should be prioritized without disregarding the complementary supportive role of parental involvement, bearing in mind that these findings are correlational in nature, drawn from a single school with a limited sample ($n = 49$), and should therefore be interpreted as an associative rather than a causal relationship.

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