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Predicting Fifth-Grade Elementary Learning Outcomes through Technology Utilization, Parental Involvement, and Learning Engagement

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Abstract

Elementary students' learning outcomes are commonly assumed to depend on classroom instruction alone, yet a growing body of research suggests that outcomes are better explained as a joint product of school-based, family-based, and student-based factors. This study examined how learning technology utilization, parental involvement, and learning engagement jointly predict the learning outcomes, measured through students' semester report-card (rapor) scores, of fifth-grade students across eight elementary schools in the Semangat Cluster, Ringinrejo District. Using a quantitative, ex post facto, causal-correlational design, data were collected through questionnaires from all 140 students (total sampling) and analyzed with multiple linear regression in Jamovi 2.7. The instrument showed strong item validity and excellent reliability (Cronbach's alpha = .962). Classical assumption checks confirmed normality, linearity, no multicollinearity, and homoscedasticity. Technology utilization (B = .275), parental involvement (B = .218), and learning engagement (B = .361) each predicted learning outcomes positively and significantly (p < .001 for all), with learning engagement emerging as the strongest predictor. The three predictors jointly explained 79.9% of the variance in learning outcomes (R^2 = .799, F(3, 136) = 181.00, p < .001). These findings suggest that raising elementary students' learning outcomes is unlikely to succeed through any single lever alone, and instead calls for coordinated attention to classroom technology use, family involvement, and students' active participation in learning, offering schools and families a practical starting point for aligning their respective roles, though the cross-sectional design means these findings describe association rather than confirmed causal impact

Introduction

Law No. 20/2003 on the National Education System frames education as the process through which Indonesia develops capable, adaptive citizens, and twenty-first-century classrooms are expected to draw on digital technology to make that process more interactive and student-centered. Used well, learning technology lets teachers present material through digital media, educational games, and interactive applications that can lift students' motivation and involvement in class (Afifah, 2023; Asrori et al., 2023). Technology integration is not the only lever available, though.

Parents remain a child's first educators, and their involvement in learning, through motivation, supervision, and the resources they provide at home, has repeatedly been linked to stronger academic performance (Epstein, 2011; Rindrayani, 2022). A third factor operates from within the student: learning engagement, the physical and mental participation a student brings to a lesson through asking questions, discussing, and completing tasks, which active-learning research treats as central to how well concepts are understood (Prince, 2004).

A preliminary study across the Semangat Cluster in Ringinrejo District suggests all three factors still have room to improve. Only about 30% of teachers used digital media routinely, and among the rest, roughly 40% could operate learning technology but not consistently, while about 30% still struggled with it; interactive panels, learning applications, and educational games were not yet used across the full range of lessons. On the family side, about half of students already had access to a personal device, but used it mostly for entertainment rather than study, and only around 40% of parents were actively involved in their children's learning, with the remainder held back by work demands or limited awareness of why home support matters. Classroom observation found a similarly uneven picture for engagement: about a quarter of students were clearly active, half moderately so, and a quarter largely passive. Against a mastery threshold of 75, about 35% of students had not yet reached it. None of these gaps sits in isolation; each plausibly reinforces the others, and together they point to a learning-outcome problem shaped by more than one cause at once.

Existing research on each of these factors, considered separately, gives reasonably consistent support. On technology, Clark et al. (2016) found that game-based digital media raised learning outcomes significantly compared with conventional instruction, and Hattie's (2008) meta-analysis likewise found that well-implemented educational technology improves learning effectiveness. Ng (2012) added that students' digital literacy itself contributes to learning success in modern classrooms, and more recent Indonesian studies point the same way: Hariyadi et al. (2025) linked learning facilities and infrastructure to national assessment results, Margareta et al. (2024) found that digital technology implementation raised elementary learning outcomes, and Runisyah (2023) reported comparable gains from educational technology use in primary classrooms. On parental involvement, Epstein's (2011) framework for school-family partnership remains a common reference point, and Thalib and Istiqamah (2021) as well as Yang's (2023) meta-analysis both found parental involvement positively associated with student engagement

and achievement. On learning engagement, Prince (2004) found active learning more effective than passive instruction for building conceptual understanding, a pattern Tegeh and Pratiwi (2023), Sayekti and Ika (2024), and Zamzani et al. (2022) each confirmed in Indonesian elementary classrooms.

These three factors are not arbitrarily grouped together. Bronfenbrenner's (1979) ecological systems theory frames a child's development, and by extension their learning, as the product of nested environmental systems operating simultaneously rather than in isolation, from the immediate settings a child moves through, such as the classroom and the home, to the individual characteristics the child brings into those settings. Read through this lens, learning technology utilization operates at the level of the school setting, parental involvement operates at the level of the family setting, and learning engagement operates at the level of the individual, the point at which the influences of the other two systems are ultimately expressed in the child's own behavior. The theory does not merely justify studying these three factors side by side; it predicts that their effects are interdependent, so that a model examining only one system in isolation risks misattributing to that system an effect that, in practice, depends on the other two as well

What is largely missing from this literature is a model that puts all three factors together. Most available studies examine educational technology, parental involvement, or learning engagement as separate predictors rather than as parts of one explanatory model, which leaves open how much each factor contributes once the other two are accounted for, and which one matters most. Understanding that relative contribution has practical value: schools, families, and policymakers each have a different lever to pull, and knowing which lever carries the most weight can help target limited resources for maximum effect. Where such integrated models do exist, they have typically been tested in secondary or online-learning settings rather than at the elementary level, and rarely at the scale of a single sub-district cluster where school-to-school variation can be observed directly a gap this study's setting in the Semangat Cluster is positioned to address

This study addressed that gap by testing a single multiple-regression model in which learning technology utilization, parental involvement, and learning engagement jointly and separately predict the learning outcomes of fifth-grade students in the Semangat Cluster, Ringinrejo District. Four questions guided the analysis: (1) does learning technology utilization predict learning outcomes; (2) does parental involvement predict learning outcomes; (3) does learning engagement predict learning outcomes; and (4) do the three

factors jointly predict learning outcomes, and if so, how much of the variance in learning outcomes can the combined model account for?

Method

This study used a quantitative, ex post facto design. An ex post facto design was appropriate because none of the three predictors, learning technology utilization, parental involvement, or learning engagement, could ethically or practically be manipulated by the researcher; each reflects a condition that had already developed naturally in students' everyday learning environment before data collection began (Stockton & Kerlinger, 1974). The specific analytic design was a causal-correlational design using multiple linear regression, chosen because the study set out to test the influence of more than one independent variable on a single dependent variable, both separately and jointly (Creswell & Creswell, 2017).

The population comprised all fifth-grade students across the eight elementary schools in the Semangat Cluster, Ringinrejo District, in the 2025/2026 academic year (N = 140). Given the relatively small and fully accessible population, a saturated sampling (total sampling) technique was used, so all 140 students served as the study sample; a small, reachable population is a common justification for total sampling in survey-based educational research (Sugiyono, 2019).

Learning technology utilization (X1) was operationally defined as students' use of and access to digital media, educational games, interactive flat panels, and their own digital literacy in support of learning. Parental involvement (X2) was defined as the motivation, supervision, learning support, and material facilitation parents reported providing at home. Learning engagement (X3) was defined as students' physical, mental, and emotional participation in class, reflected in questioning, discussion, task completion, and enthusiasm during lessons. Learning outcomes (Y), the dependent variable, were operationally defined as students' composite academic achievement across all subjects for the 2025/2026 academic year, measured through their semester report-card (rapor) scores. Data were drawn from all eight participating schools using the same report-card recording application, which produced a common scoring format across schools; this reflects a shared administrative platform rather than a formal equating of individual teachers' grading judgments across schools. Data on the three predictors were collected through structured questionnaires using a Likert-type scale, and learning-outcome data were obtained through school documentation. The questionnaires for the three predictor variables were developed

by the researchers based on theoretical indicators specific to each construct, rather than adapted from a pre-existing standardized scale; item validity and reliability were subsequently established through the psychometric testing reported below

Instrument quality was tested before the main analysis. Item validity was assessed with item-rest (corrected item-total) correlation in Jamovi 2.7, with .30 as the minimum acceptable value; all items across the three predictor scales returned coefficients between .479 and .686, comfortably above this threshold. Reliability was assessed with Cronbach's alpha and McDonald's omega, both returning .962, well above the conventional .70 cutoff, indicating high internal consistency.

Before hypothesis testing, four classical assumption checks were carried out. Normality of the regression residuals was tested with the Shapiro-Wilk test, with residuals treated as normally distributed when $p > .05$. Linearity between each predictor and the outcome was checked through the model's linear fit together with Q-Q and residual plots. Multicollinearity was assessed using tolerance and the Variance Inflation Factor (VIF), with tolerance > .10 and VIF < 10 taken as evidence of an absence of problematic collinearity (Ghozali, 2016). Homoscedasticity was checked using Jamovi's residual-versus-fitted and residual-versus-predictor plots, following the logic of the Glejser approach, with a random, patternless scatter around zero taken as evidence against heteroscedasticity.

Hypotheses were tested using multiple linear regression, following the equation $Y = a + b1X1 + b2X2 + b3X3 + e$, where Y is learning outcomes, a is the constant, b1 to b3 are the regression coefficients for the three predictors, and e is the error term. Partial effects were tested with the t-test ($\alpha = .05$), and the joint effect of all three predictors was tested with the F-test ($\alpha = .05$). The coefficient of determination (R^2) was used to estimate how much of the variance in learning outcomes the model explained. All analyses were performed in Jamovi version 2.7 (Sugiyono, 2019).

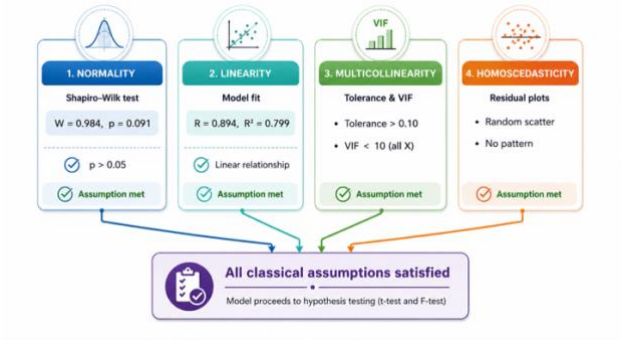

Figure 1. Diagnostic plots for the regression model: Q-Q plot of residuals and residuals-versus-predicted-values scatterplot.

Because all three predictor variables relied on self-report questionnaires completed by students and parents, responses may be subject to social desirability bias, particularly for parent-reported involvement, where respondents may describe their engagement more favorably than their actual behavior. No independent triangulation, such as classroom observation records or supporting documentation, was collected alongside the questionnaires in this study to cross-check self-reported responses.

Result and Discussion

Results

Instrument quality. Before hypothesis testing, the questionnaire's item validity and reliability were examined. Item-rest correlations for all three predictor scales exceeded the .30 threshold (Table 1), and the combined instrument returned a Cronbach's alpha and McDonald's omega of .962 (Table 2), indicating excellent internal consistency.

Table 1. Item Validity of the Research Instrument

Variable	Number of items	Item-rest correlation range	Criterion	Conclusion
Technology utilization (X1)	25	.479–.686	> .30	All items valid
Parental involvement (X2)	25	.491–.644	> .30	All items valid
Learning engagement (X3)	25	≥ .30	> .30	All items valid

Based on the validity test results in Table 1, all items across the three variables were declared valid, as their item-rest correlation values exceeded the established criterion (> .30). Subsequently, to ensure the internal consistency of the instrument, a reliability test was conducted, the results of which are shown in Table 2.

Table 2. Reliability of the Research Instrument

Variables	Cronbach's alpha	McDonald's omega	Criterion	Conclusion
X1, X2, X3 (combined instrument)	.962	.962	≥ .70	Excellent reliability

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Before assumption and hypothesis testing, the four variables' descriptive statistics were examined (Table X). All four variables clustered in a broadly similar range (means between 84.8 and 85.7 on a comparable scale, minimal skew between mean and median), consistent with a sample without extreme outliers driving the subsequent regression results.

Table 3. Descriptive Statistics of Research Variables

Variable	N	Min	Max	Mean	Median	SD
Technology utilization (X1)	140	68	97	84.9	85.0	5.08
Parental involvement (X2)	140	70	98	84.8	85.0	5.85
Learning engagement (X3)	140	69	96	85.7	86.0	5.00
Learning outcomes (Y)	140	77	96	85.3	85.0	4.07

Classical assumption tests. The Shapiro-Wilk test returned a non-significant result ($p = .091$), supporting the assumption that the regression residuals were normally distributed (Table 4). The model's linear fit ($R = .894$, $R^2 = .799$) together with Q-Q and residual plots supported the linearity assumption (Table 4); in the plots, residual points followed the diagonal reference line and scattered randomly around zero without forming a curved, funnel-shaped, or wave-like pattern. Tolerance and VIF values for all three predictors fell well within the acceptable range (tolerance > .10, VIF < 10), indicating an absence of problematic multicollinearity (Table 5). Residual-versus-fitted and residual-versus-predictor plots showed a similarly random scatter for all three predictors, supporting the homoscedasticity assumption (Table 6). Taken together, these checks indicated that the data met the assumptions required for multiple linear regression, so hypothesis testing could proceed.

Table 4. Normality Test of Regression Residuals

Test	Statistic	Sig.	Conclusion
Shapiro–Wilk	.984	.091	Residuals normally distributed

The Shapiro-Wilk test results in Table 4 show a significance value of .091 (> .05), indicating that the residuals are normally distributed and the normality assumption is

satisfied. Subsequently, the regression model was tested to examine the strength of the relationship among variables and to verify that the linearity assumption was met, as presented in Table 5.

Table 5. Regression Model Summary and Linearity Check

Model	R	R^2	Conclusion
Multiple linear regression	.894	.799	Linearity assumption met; model fit for hypothesis testing

The regression model in Table 5 shows an R^2 value of .799, indicating strong predictive power and confirming that the linearity assumption was met. To ensure the absence of redundancy among the independent variables, a multicollinearity test was subsequently conducted, the results of which are presented in Table 6.

Table 6. Multicollinearity Test

Predictor	Tolerance	VIF	Conclusion
Technology utilization (X1)	.659	1.52	No multicollinearity
Parental involvement (X2)	.635	1.58	No multicollinearity
Learning engagement (X3)	.643	1.56	No multicollinearity

The multicollinearity test results in Table 5 show tolerance values above .10 and VIF values below 10 for all predictor variables, indicating no multicollinearity among the independent variables. Subsequently, a heteroscedasticity check was performed through residual plot analysis to ensure that the variance of the residuals remained constant, as presented in Table 7.

Table 7. Heteroscedasticity Check (Residual Plots)

Assumption check	Observation	Interpretation
Residuals vs Fitted	Random scatter, no pattern	No heteroscedasticity
Residuals vs Y	No systematic pattern	Homoscedasticity holds

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Assumption check	Observation	Interpretation
Residuals vs X1	Random scatter	No heteroscedasticity
Residuals vs X2	Random scatter	No heteroscedasticity
Residuals vs X3	Random scatter	No heteroscedasticity

Partial effects (t-test). All three predictors showed a positive, statistically significant relationship with learning outcomes (Table 8). Technology utilization returned B = .275 (t = 7.18, p < .001), parental involvement returned B = .218 (t = 6.23, p < .001), and learning engagement returned B = .361 (t = 9.21, p < .001), the largest coefficient of the three. On a standardized basis, learning engagement's beta coefficient (.441) was likewise the highest among the three predictors.

Table 8. Partial Regression Results (t-test)

Predictor	B	t	Sig.	Decision
Technology utilization (X1)	.275	7.18	< .001	H0 rejected, Ha accepted
Parental involvement (X2)	.218	6.23	< .001	H0 rejected, Ha accepted
Learning engagement (X3)	.361	9.21	< .001	H0 rejected, Ha accepted

Joint effect (F-test) and model fit. The overall regression model was statistically significant, F(3, 136) = 181.00, p < .001 (Table 9), meaning the three predictors jointly and significantly predicted learning outcomes. The model returned a correlation coefficient of R = .894 and a coefficient of determination of R^2 = .799, meaning the three predictors together accounted for 79.9% of the variance in learning outcomes, leaving 20.1% attributable to factors outside the model.

Table 9. Simultaneous Regression Results (F-test)

Model	R	R^2	F	df	Sig.	Decision
Multiple linear regression	.894	.799	181.00	3, 136	< .001	H0 rejected, Ha accepted

The F-test results in Table 9 show an F value of 181.00 with a significance of < .001, indicating that the three independent variables (X1, X2, X3) simultaneously have a significant effect on the dependent variable, thus rejecting H0 and accepting Ha. To further

illustrate the relative contribution of each predictor, a comparison of standardized coefficients (t-values) is presented in Figure 2.

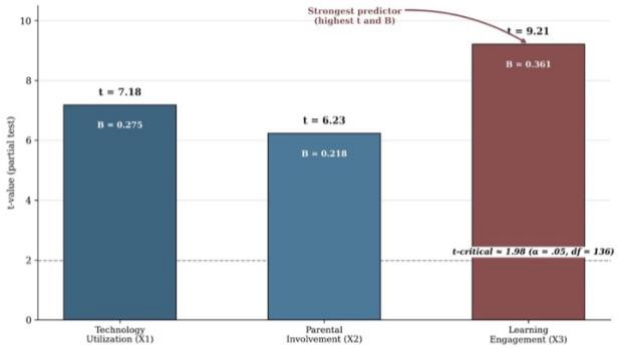

Figure 2. Comparison of standardized coefficients (t-values) across the three predictors, showing learning engagement as the strongest predictor.

Discussion

The positive coefficient for technology utilization is consistent with a reasonably substantial body of prior work. Clark et al. (2016) and Hattie (2008) both found that well-implemented educational technology raises learning effectiveness, and the present result, B = .275 with $p < .001$, fits that pattern without needing to overstate it: technology use here explains part of the variance in learning outcomes, not all of it. This sits alongside the preliminary finding that only around 30% of teachers in the Semangat Cluster used digital media routinely, which suggests that even partial or inconsistent technology use was already associated with measurably better outcomes, and that more consistent use might extend the effect further, a claim this cross-sectional design cannot confirm on its own.

Parental involvement also predicted learning outcomes positively (B = .218, $p < .001$), in line with Epstein's (2011) account of school-family partnership and with more recent findings from Thalib and Istiqamah (2021) and Yang's (2023) meta-analysis. The preliminary data showing only about 40% of parents actively engaged in their children's learning suggests there is real room for schools to strengthen this channel, for instance through more structured parent-teacher communication, without assuming that involvement alone would close the entire achievement gap given its comparatively smaller coefficient among the three predictors.

Taken together, these results point toward a specific practical sequencing rather than an either-or choice between investing in classroom hardware and strengthening

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parental involvement. Because learning engagement carried the largest coefficient, schools may get more return from pairing technology use with strategies that keep students actively participating, such as short discussion prompts embedded in a digital lesson, rather than treating device or platform acquisition as sufficient on its own. Parent-teacher communication, in turn, can be aimed specifically at the behaviors linked to engagement, for example encouraging parents to ask children what they discussed in class that day, rather than focusing only on monitoring device use at home

Learning engagement carried the largest coefficient (B = .361, standardized beta = .441) and the highest t-value (9.21) of the three predictors, consistent with active-learning research going back to Prince (2004) and more recent Indonesian classroom studies (Tegeh & Pratiwi, 2023; Sayekti & Ika, 2024; Zamzani et al., 2022). This is a meaningful pattern rather than a marginal one: of the three levers examined, the one most directly under a teacher's daily influence during instruction, how much students question, discuss, and participate, appears to matter most for learning outcomes in this sample. That does not make technology and parental involvement dispensable; a model that omitted them would explain less variance, and the assumption tests indicate none of the three predictors is redundant with another (all tolerance values exceeded .60).

The model's R^2 of .799 is a substantial figure and should be read with some caution rather than as a settled fact about the underlying population. A single cross-sectional sample of 140 students drawn from one cluster of schools is not necessarily representative of fifth-graders elsewhere, and an ex post facto design of this kind establishes association, not causal direction; it remains possible, for example, that students who are already doing well engage more actively in class rather than the reverse. The remaining 20.1% of unexplained variance is also worth taking at face value: it points to factors this model did not measure, such as students' prior ability, teacher competence, school climate, or family socioeconomic conditions, any of which could matter as much as, or more than, the three factors examined here.

Because all three predictors and, in the case of parental involvement and learning engagement, effectively the same respondent pool were measured through self-report questionnaires administered at a single time point, some portion of the shared variance across variables may reflect common method variance rather than substantive relationships alone. This study did not conduct a formal test, such as Harman's single-factor test, to quantify this risk, and future research collecting predictor and outcome data from different

sources or at different time points would help establish how much of the observed R^2 reflects the underlying relationships versus shared measurement method.

Limitations

Beyond the causal-direction caveat already noted, this study relied on self-report and questionnaire-based measures for all three predictors, which may be subject to social-desirability bias, particularly for parent-reported involvement; no independent triangulation, such as classroom observation records or supporting documentation, was collected alongside the questionnaires to cross-check these self-reported responses. The sample, while covering the entire population of the Semangat Cluster, was limited to a single sub-district, and the cross-sectional design captured a single point in time rather than change over the school year. Future research using longitudinal data, multiple school clusters, or teacher observation records and structured parent-teacher communication logs in place of self-report measures for engagement and parental involvement would help establish how robust these relationships are beyond this specific sample and reduce reliance on a single self-report source for constructs prone to social-desirability bias.

Because the outcome measure in this study reflects composite achievement across all subjects rather than a subject-specific score, future research particularly given the authors' disciplinary grounding in Social Studies education could test whether these relationships hold similarly for domain-specific outcomes such as Social Studies achievement in particular.

Conclusion

This study examined whether learning technology utilization, parental involvement, and learning engagement predict the learning outcomes of fifth-grade students in the Semangat Cluster, Ringinrejo District, both separately and jointly. All three predictors showed a positive, statistically significant partial relationship with learning outcomes, and learning engagement emerged as the strongest of the three. Together, the predictors accounted for 79.9% of the variance in learning outcomes ($R^2 = .799$), a joint effect confirmed by a significant F-test, $F(3, 136) = 181.00$, $p < .001$. These results suggest that elementary learning outcomes are better understood as the product of coordinated factors across the classroom, the home, and the student, rather than as the result of any single intervention. Given the cross-sectional, single-cluster design, this conclusion should be read as evidence supporting a multi-factor view of learning outcomes rather than as proof of a

fixed causal hierarchy among the three predictors; replication across other school clusters and with longitudinal data would help establish how far these findings generalize.

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