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Analyzing the Improvement of Primary Education Quality through Impactful Learning: The Mechanisms of Teaching Quality, Student Engagement, and Learning Impact

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Abstract
This study examines how impactful learning explains the mechanism of primary education quality improvement through the relationships among Enabling Conditions for Learning, Teaching Quality, Student Engagement, Learning Impact, and Primary Education Quality. Using empirical data from 400 valid observations representing five latent constructs measured by 25 Likert-scale indicators (five per construct), the study applies Partial Least Squares Structural Equation Modeling (PLS-SEM) to test a structural model comprising seven direct paths and three mediation mechanisms. The measurement model shows adequate indicator reliability (loadings 0.812–0.872), internal consistency (Cronbach's alpha 0.891–0.905; composite reliability 0.920–0.929), convergent validity (AVE 0.696–0.724), and discriminant validity (HTMT ≤ 0.649). The structural model indicates that Enabling Conditions for Learning significantly predict Teaching Quality (β = 0.398), which subsequently predicts Student Engagement (β = 0.428) and, together with Student Engagement, predicts Learning Impact (β = 0.358 and 0.432, respectively). Learning Impact, Student Engagement, and Enabling Conditions for Learning jointly explain 40.0% of the variance in Primary Education Quality. Bootstrap analysis using 1,500–2,000 resamples confirms that all seven direct paths and three mediation pathways are statistically significant. The findings demonstrate that primary education quality can be understood through a sequential mechanism in which enabling conditions contribute to teaching quality, teaching quality promotes student engagement, and both teaching quality and student engagement contribute to learning impact, which subsequently contributes to primary education quality. The study provides an empirically tested measurement and structural framework for understanding and further investigating impactful learning as a mechanism for primary education quality improvement.

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1. INTRODUCTION

The quality of primary education constitutes a fundamental foundation for the success of the education system as a whole, as it is at this level that students' basic literacy, numeracy, and character competencies are first systematically developed. Various studies have demonstrated that improving the quality of primary education cannot be understood merely as an improvement in learning outcomes at the output level; rather, it must be examined through the learning mechanisms that generate such outcomes. Approaches that focus exclusively on students' final scores tend to overlook the sequence of pedagogical

processes, student engagement, and enabling conditions that actually drive changes in educational quality. This condition highlights the need for an analytical framework capable of explaining the quality of primary education as the result of a multilevel mechanism of impactful learning, rather than merely as a single correlation between educational inputs and outputs.

The concept of impactful learning emphasizes that meaningful learning should produce tangible changes in students' understanding, thinking skills, and motivation, rather than merely ensuring the completion of instructional content. Within this framework, teaching quality is regarded as a core pedagogical mechanism that bridges enabling school conditions with students' active engagement in the learning process. Structural equation modeling research involving primary and secondary schools in Bangladesh has demonstrated that teacher quality and school leadership significantly influence student achievement, which in turn determines overall school quality (Ahmmed et al., 2022). This finding reinforces the argument that educational quality is a multilayered construct shaped through a chain of interconnected mechanisms rather than a single, stand-alone variable.

A growing body of recent research further reinforces the role of teaching quality in determining student engagement and achievement. Positive associations have been identified between the quality of mathematics and English teaching and students' learning achievement (Engida et al., 2024). Student engagement has also been consistently identified as an important mediating mechanism linking teaching quality with academic performance (Huang, 2024; Wong et al., 2024). Longitudinal evidence from secondary school students in Australia further indicates that effective teaching practices influence academic achievement through student engagement as an intervening pathway (Tomaszewski et al., 2022). Studies examining technology-supported classroom environments and teachers' instructional strategies similarly demonstrate that student engagement—behavioral, cognitive, and emotional—functions as a bridge through which teaching quality is translated into meaningful learning impacts (Wang et al., 2022; Zhang et al., 2024).

On the other hand, learning impact itself is increasingly recognized as a direct determinant of broader educational quality. Reading engagement has been shown to mediate the influence of instructional quality on literacy achievement in cross-national data (Qiu & Liu, 2024), while perceived social support and learning engagement have been found to mutually reinforce the development of educational outcomes (Liu, 2024; Wang et al., 2024). At the institutional level, enabling conditions for learning—including instructional leadership, teacher professional development, and professional learning collaboration—are equally important. Educational leadership has been shown to enhance instructional quality and student achievement in Austrian primary schools (Kemethofer et al., 2025), while instructional leadership has been found to influence teachers' instructional quality through teacher academic optimism as a mediating mechanism (Wang et al., 2026). Teaching quality at the institutional level has likewise been closely associated with students' learning engagement (Nguyen, 2024).

Evidence from formative assessment research further supports this mechanism. An umbrella review of multiple meta-analyses of formative assessment across K–12 education concluded that formative assessment generally contributes positively to student achievement, although the strength of the evidence varies across studies (Sortwell et al., 2024). This finding reinforces the assumption that teaching quality—one dimension of which involves feedback and instructional differentiation—plays an important role as a mechanism linking enabling school conditions with student engagement. Nevertheless, most previous studies have examined these relationships only partially: some have focused on teaching quality and student engagement, while others have examined leadership and instructional quality, without integrating the entire chain of mechanisms into a single

structural model simultaneously linking enabling conditions for learning, teaching quality, student engagement, learning impact, and the quality of primary education.

This research gap constitutes the point of departure for the present study. An integrated structural model is needed that not only examines direct relationships among constructs but also traces the sequential mediation mechanisms through which enabling conditions for learning ultimately contribute to the quality of primary education through teaching quality, student engagement, and learning impact. The novelty of this study lies in its attempt to develop and methodologically test a structural model that simultaneously connects these five constructs, positioning learning impact as a proximal outcome and the quality of primary education as a broader outcome, while also examining both single and serial mediation pathways among them.

The present study empirically examines the proposed quantitative model using valid empirical data from 400 observations. Accordingly, the study is positioned as an empirical examination of the relationships among enabling conditions for learning, teaching quality, student engagement, learning impact, and primary education quality. The empirical analysis is intended to provide evidence regarding the direct, indirect, and sequential relationships among these constructs within the proposed impactful learning framework.

Based on the preceding discussion, this study aims to analyze the effect of Enabling Conditions for Learning on Teaching Quality; the effects of Teaching Quality on Student Engagement and Learning Impact; the effects of Student Engagement on Learning Impact and Primary Education Quality; the effects of Learning Impact and Enabling Conditions for Learning on Primary Education Quality; to examine single and serial mediation mechanisms among these constructs; and to comprehensively evaluate the methodological feasibility of the proposed structural model of impactful learning.

2. RESEARCH METHODS

This study employed a quantitative explanatory research design using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach and was explicitly not a systematic literature review, bibliometric analysis, or scoping review. The literature discussed in the Introduction was used solely as the conceptual foundation for formulating the research model and hypotheses, rather than as the research method. The structural model examined five latent constructs, namely Enabling Conditions for Learning (KPP), Teaching Quality (KP), Student Engagement (KS), Learning Impact (DP), and Primary Education Quality (MPD), which were connected through seven structural paths: KPP → KP, KP → KS, KP → DP, KS → DP, DP → MPD, KS → MPD, and KPP → MPD.

The data used in this study consisted of N = 400 valid observations for empirically testing the proposed PLS-SEM model. Each construct was measured using five indicators on a 1–5 Likert scale, resulting in a total of 25 indicators (see Table 1). The operationalization of the indicators followed a predefined codebook established prior to data analysis, and no indicators were removed or modified to improve the statistical results.

As presented in Table 1, the five constructs and their twenty-five indicators represent the theoretical dimensions described in the Introduction.

Table 1. Constructs, Indicators, and Operational Descriptions

Construct	Indicator	Operational Description
Enabling Conditions for Learning (KPP)	KPP1	Leadership support for learning improvement
	KPP2	Opportunities for professional development
	KPP3	Professional collaboration / professional learning communities
	KPP4	Availability of resources and learning support

	KPP5	Use of assessment information to support learning
Teaching Quality (KP)	KP1	Clarity and structure of instruction
	KP2	Classroom management and learning environment
	KP3	Cognitive activation
	KP4	Dialogic and active learning
	KP5	Differentiation and instructional responsiveness
Student Engagement (KS)	KS1	Behavioral engagement
	KS2	Cognitive engagement
	KS3	Emotional engagement
	KS4	Active participation
	KS5	Persistence and self-regulation
Learning Impact (DP)	DP1	Conceptual understanding
	DP2	Literacy/numeracy
	DP3	Critical thinking and problem solving
	DP4	Transfer and application of learning
	DP5	Motivation and self-efficacy
Primary Education Quality (MPD)	MPD1	Quality of the learning process
	MPD2	Quality of learning outcomes
	MPD3	Equity and inclusiveness
	MPD4	Student engagement/satisfaction
	MPD5	Continuous quality improvement

Data analysis was conducted through several stages. First, an audit of the raw data (Raw_Data) was performed, including examination of the number of cases, number of indicators, missing values, value ranges, and consistency of indicator direction with their respective constructs. The audit results showed that there were no missing values across the 400 × 25 data cells, all values were within the 1–5 range corresponding to the specified Likert scale, and all indicators were consistent with the direction of their respective constructs.

Second, PLS-SEM estimation was performed using the standard iterative Wold algorithm with the path weighting scheme, implemented through the *plspm* library in Python rather than SmartPLS software. All outer loadings, path coefficients, reliability coefficients, and validity measures reported in this article were recalculated directly from the Raw_Data using the PLS-SEM algorithm. These estimates were therefore distinguished from the values contained in the *Structural_OLS_Approx*, *Effect_Size_f2_Approx*, and *HTMT_Approx* worksheets, which were retained as preliminary/diagnostic approximations. The results obtained from the PLS-SEM algorithm were consistent with those obtained from an independent OLS-based approach using standardized composite scores. Accordingly, the final estimates reported in this study are based on the PLS-SEM algorithm.

Third, the measurement model (outer model) was evaluated through outer loadings, internal consistency reliability using Cronbach's Alpha and Composite Reliability (rho_c) following the Dillon–Goldstein criterion, convergent validity using Average Variance

Extracted (AVE), and discriminant validity using the Heterotrait–Monotrait (HTMT) ratio, following the criteria proposed by Henseler et al. (2015).

Fourth, the structural model (inner model) was evaluated by examining collinearity through the Variance Inflation Factor (VIF), path coefficients, coefficients of determination (R^2 and adjusted R^2), effect sizes (f^2), and predictive relevance (Q^2) using 10-fold cross-validation as an approach to the blindfolding procedure, following the PLS-SEM guidelines proposed by Hair et al. (2022) and Hair et al. (2019).

Fifth, the significance of the path coefficients was tested using a bootstrapping procedure with 1,500 resamples based on the full PLS-SEM algorithm. The results were further cross-validated using an additional 2,000-resample bootstrap procedure based on standardized composite scores to calculate confidence intervals for both direct and indirect effects (mediation). Both procedures produced consistent point estimates and confidence intervals, providing additional support for the stability of the estimated relationships. Ideally, as recommended in PLS-SEM practice, bootstrapping should be conducted using 5,000 resamples; however, computational resource constraints in the analytical environment limited the number of resamples to 1,500 in the primary PLS-SEM procedure. This limitation is explicitly acknowledged as a methodological limitation of the study.

Sixth, mediation analysis was conducted for three indirect pathways, namely KP → KS → DP (H8), KS → DP → MPD (H9), and the serial mediation pathway KP → KS → DP → MPD (H10). The mediation analysis reported the indirect-effect coefficients, standard errors, t-statistics, and 95% confidence intervals based on the percentile bootstrap method.

The analytical procedure was designed to ensure that the evaluation of the proposed model covered both the quality of the measurement instruments and the structural relationships among the latent constructs. The measurement model was used to establish whether the indicators adequately represented their respective constructs, whereas the structural model was used to examine the proposed relationships among enabling conditions for learning, teaching quality, student engagement, learning impact, and primary education quality. The mediation analysis further examined whether the relationships among these constructs operated through intermediate mechanisms rather than solely through direct effects.

The empirical analysis was therefore directed toward testing the proposed impactful learning mechanism within an integrated structural framework. Specifically, the analysis examined whether enabling conditions for learning contribute to teaching quality; whether teaching quality contributes to student engagement and learning impact; whether student engagement contributes to learning impact and primary education quality; and whether learning impact contributes to primary education quality. The analysis also examined whether student engagement and learning impact function as mediating mechanisms through which upstream conditions and teaching quality are translated into broader educational quality outcomes.

Overall, the methodological procedure combined measurement-model assessment, structural-model evaluation, predictive assessment, bootstrapping, and mediation analysis to provide a comprehensive empirical examination of the proposed model. This approach was intended not only to identify the statistical relationships among the constructs but also to clarify the sequential mechanism through which enabling conditions for learning may be translated into teaching quality, student engagement, learning impact, and ultimately the quality of primary education.

3. RESULTS AND DISCUSSION

3.1. Research Results

3.1.1 Descriptive Statistics and Measurement Model

The descriptive audit of the Raw_Data showed that the five constructs had relatively homogeneous score distributions around the midpoint of the Likert scale. The mean composite scores were KPP = 2.99 (SD = 0.98), KP = 3.00 (SD = 1.00), KS = 3.00 (SD = 0.98), DP = 2.99 (SD = 1.01), and MPD = 2.99 (SD = 0.99). This pattern indicates that the five constructs had relatively balanced score distributions around the midpoint of the Likert scale. The descriptive statistics provide an overview of the observed distribution of the empirical data and serve as a preliminary description before evaluating the measurement and structural models.

The evaluation of the measurement model showed that all 25 indicators had outer loadings ranging from 0.812 to 0.872, exceeding the threshold of 0.70 required for reflective measurement models (Hair et al., 2022). Internal consistency reliability was also achieved, with Cronbach's Alpha ranging from 0.891 (KPP) to 0.905 (KP) and Composite Reliability (rho_c) ranging from 0.920 (KPP) to 0.929 (KP and MPD), both exceeding the threshold of 0.70. Convergent validity was also established, with Average Variance Extracted (AVE) values ranging from 0.696 (KPP) to 0.724 (KP), all exceeding the threshold of 0.50, as presented in Table 2.

Table 2. Measurement Model: Outer Loading Range, Reliability, and AVE

Construct	Loading Range	Cronbach's Alpha	Composite Reliability (rho_c)	AVE
KPP	0.812–0.854	0.891	0.920	0.696
KP	0.817–0.872	0.905	0.929	0.724
KS	0.819–0.871	0.896	0.923	0.707
DP	0.831–0.862	0.901	0.926	0.716
MPD	0.841–0.861	0.904	0.929	0.722

Discriminant validity was assessed using the Heterotrait–Monotrait (HTMT) ratio, as presented in Table 5 at the end of this section. All HTMT values between constructs ranged from 0.166 to 0.649, well below the conservative threshold of 0.85 (Henseler et al., 2015), confirming discriminant validity across all constructs. Thus, the measurement model (outer model) satisfied the criteria for indicator reliability, internal consistency, convergent validity, and discriminant validity separately, in accordance with PLS-SEM methodological principles, which do not permit construct validity to be assessed solely on the basis of Cronbach's Alpha.

3.1.2 Structural Model and Hypothesis Testing

Before testing the structural paths, collinearity was assessed using the Variance Inflation Factor (VIF) for all predictors of each endogenous construct. All VIF values ranged from 1.049 to 1.554, well below the threshold of 5 and even below the conservative threshold of 3. Therefore, no collinearity problems were identified that could bias the estimation of the path coefficients.

The structural model estimation results, as presented in Table 3, showed that all seven hypothesized direct paths were statistically significant based on 1,500 bootstrap resamples. Enabling Conditions for Learning had a positive and significant effect on Teaching Quality ($\beta = 0.398$; $t = 9.83$; $p < 0.001$), supporting H1. Teaching Quality had positive and significant effects on Student Engagement ($\beta = 0.428$; $t = 10.99$; $p < 0.001$) and Learning Impact ($\beta = 0.358$; $t = 8.66$; $p < 0.001$), supporting H2 and H3. Student Engagement had a positive and significant effect on Learning Impact ($\beta = 0.432$; $t = 10.46$; $p < 0.001$), supporting H4. Learning Impact had a positive and significant effect on Primary Education Quality ($\beta = 0.403$; $t = 8.29$; $p < 0.001$), supporting H5. Student Engagement also had a positive and significant direct effect on Primary Education Quality ($\beta = 0.252$; $t = 5.24$; p

< 0.001), supporting H6. Likewise, Enabling Conditions for Learning had a positive and significant effect on Primary Education Quality (β = 0.140; t = 3.52; p < 0.001), supporting H7.

Table 3. Structural Model: Path Coefficients, t-Statistics, p-Values, Confidence Intervals, and R-Square

Path	β	SE	t	p	95% CI	f²
KPP → KP	0.398	0.042	9.83	<0.001	[0.315, 0.480]	0.186
KP → KS	0.428	0.041	10.99	<0.001	[0.346, 0.508]	0.222
KP → DP	0.358	0.040	8.66	<0.001	[0.278, 0.430]	0.191
KS → DP	0.432	0.038	10.46	<0.001	[0.352, 0.502]	0.272
KPP → MPD	0.140	0.039	3.52	<0.001	[0.067, 0.212]	0.029
KS → MPD	0.252	0.048	5.24	<0.001	[0.156, 0.343]	0.066
DP → MPD	0.403	0.049	8.29	<0.001	[0.314, 0.495]	0.177

The model explained varying proportions of variance across the endogenous constructs: R^2 for Teaching Quality = 0.158 (adjusted R^2 = 0.156), Student Engagement = 0.183 (adjusted R^2 = 0.182), Learning Impact = 0.447 (adjusted R^2 = 0.444), and Primary Education Quality = 0.400 (adjusted R^2 = 0.395). Following the criteria of Hair et al. (2022), the R^2 values for Learning Impact and Primary Education Quality were categorized as moderate, whereas those for Teaching Quality and Student Engagement were categorized as weak to moderate, which reasonably reflects the fact that these two constructs were predicted by only one directly connected exogenous variable in the model. Predictive relevance (Q^2), calculated through 10-fold cross-validation, showed positive values for all endogenous constructs (KP = 0.146; KS = 0.176; DP = 0.435; MPD = 0.382), indicating that the model had adequate predictive relevance for all endogenous constructs.

The effect sizes (f^2) reported in Table 3 showed that the KS → DP path had the largest effect (f^2 = 0.272, approaching the large-effect category), followed by KP → KS (f^2 = 0.222) and KPP → KP (f^2 = 0.186), which were categorized as moderate-to-large effects. The KPP → MPD path had the smallest effect (f^2 = 0.029), which according to Cohen's criteria was categorized as a small effect, although it remained statistically significant. This finding is important to report transparently: statistical significance of a path is not necessarily accompanied by a large effect size, and the small f^2 for KPP → MPD indicates that the direct effect of Enabling Conditions for Learning on Primary Education Quality is largely transmitted through indirect mechanisms rather than through the direct pathway itself.

The structural relationships tested in this study are presented in Figure 1.

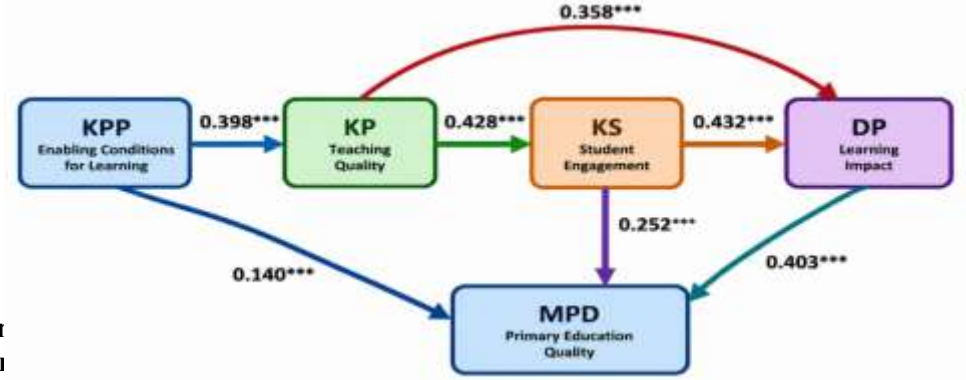
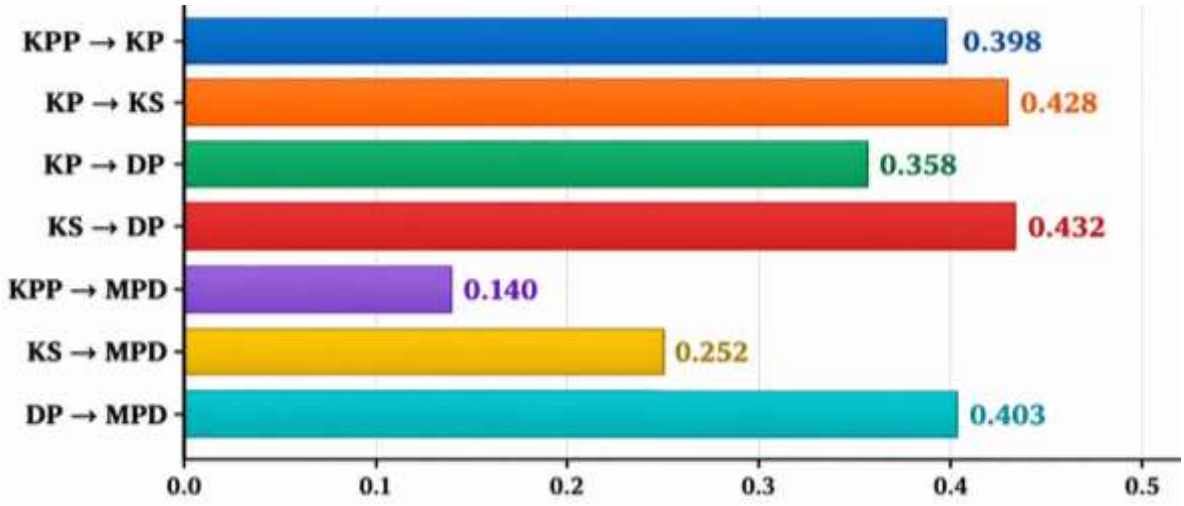


Figure 1. Structural Model of Impactful Learning and Primary Education Quality

The relative magnitudes of the seven standardized structural path coefficients are visually presented in Graph 1.



Graph 1. Standardized Structural Path Coefficients

3.1.3 Mediation Analysis

As shown in Table 4, the mediation analysis using 2,000 bootstrap resamples showed that all three hypothesized indirect pathways were statistically significant. Student Engagement mediated the effect of Teaching Quality on Learning Impact (H8: indirect effect = 0.182; t = 7.30; 95% CI [0.134, 0.234], not crossing zero), supporting H8. Learning Impact mediated the effect of Student Engagement on Primary Education Quality (H9: indirect effect = 0.177; t = 6.98; 95% CI [0.129, 0.228]), supporting H9. Because the direct paths KP → DP and KS → MPD were also significant (Table 3), both mediation effects were classified as partial mediation, rather than full mediation.

The serial mediation analysis (H10), linking Teaching Quality to Primary Education Quality through Student Engagement and Learning Impact sequentially (KP → KS → DP → MPD), was also statistically significant (serial indirect effect = 0.075; t = 5.52; 95% CI [0.051, 0.104]), supporting H10. This finding confirms that the effect of Teaching Quality on Primary Education Quality is not transmitted through only a single indirect pathway, but also through a sequential mediation chain involving both Student Engagement and Learning Impact, consistent with the theoretical argument developed in the Introduction.

Table 4. Direct, Indirect, and Total Effects (Mediation Analysis)

Hypothesis / Path	Indirect β	SE	t	95% CI	Result / Type
H8: KP → KS → DP	0.182	0.025	7.30	[0.134, 0.234]	Significant (partial)
H9: KS → DP → MPD	0.177	0.025	6.98	[0.129, 0.228]	Significant (partial)
H10: KP → KS → DP → MPD (serial)	0.075	0.014	5.52	[0.051, 0.104]	Significant

Table 5. Discriminant Validity (Heterotrait–Monotrait Ratio / HTMT)

Construct	KPP	KP	KS	DP	MPD
KPP	–	0.441	0.166	0.239	0.290
KP	0.441	–	0.474	0.602	0.401
KS	0.166	0.474	–	0.649	0.560
DP	0.239	0.602	0.649	–	0.643

MPD	0.290	0.401	0.560	0.643	–

3.2. Discussion

The main findings of this study indicate that the improvement of primary education quality can be explained as the result of a series of sequential impactful learning mechanisms, rather than as the effect of a single determining variable. The path from Enabling Conditions for Learning to Teaching Quality (KPP → KP; β = 0.398) confirms that enabling conditions—including leadership support, opportunities for professional development, and the availability of resources—function as enabling conditions that determine the extent to which teaching quality can be realized in the classroom. This finding is consistent with previous evidence showing that educational leadership enhances instructional quality in primary schools and that instructional leadership influences teachers' instructional quality (Kemethofer et al., 2025; Wang et al., 2026). However, the R^2 of 0.158 for Teaching Quality also indicates that other factors beyond enabling conditions contribute to the formation of teaching quality. Therefore, the present model is not intended as an exhaustive explanation, but rather as one relevant explanatory pathway.

The KP → KS path (β = 0.428) confirms that teaching quality—including instructional clarity and structure, cognitive activation, and dialogic learning—constitutes a pedagogical mechanism that consistently promotes student engagement across behavioral, cognitive, and emotional dimensions. This finding is consistent with previous empirical evidence identifying student engagement as a pathway linking teaching quality with academic achievement (Huang, 2024; Wong et al., 2024; Tomaszewski et al., 2022). Interestingly, teaching quality in the present model also has a direct effect on learning impact (KP → DP; β = 0.358), in addition to its indirect effect through student engagement (H8; indirect effect = 0.182). This pattern indicates that teaching quality has a dual pathway toward learning impact: part of its influence is transmitted directly, for example, through the clarity of instructional delivery that directly enhances conceptual understanding, while another part is transmitted through the student engagement that is established beforehand. This partial mediation is theoretically important because it demonstrates that student engagement is not the only explanatory pathway between teaching quality and learning impact.

The KS → DP path (β = 0.432), which represents the largest coefficient in the model, confirms that student engagement constitutes a particularly strong behavioral and cognitive mechanism for promoting learning impact, including conceptual understanding, critical thinking, and self-efficacy. This finding reinforces previous evidence indicating that learning engagement functions as a proximal determinant of learning achievement that may exert a stronger relationship than a number of institutional factors (Qiu & Liu, 2024; Liu, 2024). The KP → KS → DP → MPD pattern subsequently forms a statistically significant serial mediation pathway (H10), although its magnitude is relatively small (0.075). This pattern is reasonably expected because the effect passes through three sequential pathways, each with a coefficient below one; therefore, the smaller magnitude does not necessarily indicate a weakness of the model, but rather reflects the mathematical consequence of sequential mediation.

At the broader outcome level, Learning Impact, Student Engagement, and Enabling Conditions for Learning jointly explain 40.0% of the variance in Primary Education Quality. Learning Impact was the strongest predictor (β = 0.403), followed by Student Engagement (β = 0.252) and Enabling Conditions for Learning (β = 0.140). This pattern is consistent with the argument that primary education quality should be understood as an outcome shaped proximally by tangible learning impacts rather than solely by input conditions at the school level. Nevertheless, the direct effect of KPP → MPD, although

statistically significant, had a small effect size ($f^2 = 0.029$), indicating that the contribution of enabling conditions to primary education quality is largely transmitted indirectly through teaching quality, student engagement, and learning impact rather than through the direct effect itself. This interpretation is important to report transparently because statistical significance in a sample of N = 400 does not necessarily imply substantial practical relevance.

Overall, these findings provide empirical support for the mechanism framework proposed in the Introduction: enabling conditions shape teaching quality, teaching quality shapes student engagement, and these mechanisms jointly contribute to learning impact, which ultimately contributes to primary education quality, both directly and through student engagement. The findings therefore support the proposed sequential mechanism linking Enabling Conditions for Learning → Teaching Quality → Student Engagement → Learning Impact → Primary Education Quality, while also demonstrating the presence of additional direct relationships within the structural model.

Several limitations should nevertheless be acknowledged openly. First, although the study uses valid empirical data from 400 observations, the sample does not necessarily represent the full diversity of primary education contexts; consequently, the generalizability of the findings to other schools, teachers, and students should be considered with caution. Second, the cross-sectional nature of the data limits the extent to which the reported structural relationships can be interpreted as causal relationships occurring over time. Third, the bootstrap procedure used for testing the structural paths employed 1,500 resamples, below the commonly recommended 5,000 resamples, because of computational resource constraints. Although the results obtained from the bootstrap procedure were consistent with the additional 2,000-resample analysis, replication using a larger number of bootstrap resamples is recommended. Fourth, predictive relevance (Q^2) was calculated using a 10-fold cross-validation approach based on composite scores as a proxy for the standard blindfolding procedure available in commercial PLS-SEM software; consequently, the reported Q^2 values should be interpreted as indicative. Future research should therefore replicate the proposed model using additional empirical samples across different primary education contexts and, where possible, employ longitudinal or multi-source designs to further examine the stability and generalizability of the proposed relationships.

4. CONCLUSION

This study demonstrates that the improvement of primary education quality can be explained through an impactful learning mechanism that sequentially connects enabling conditions for learning, teaching quality, student engagement, and learning impact. Testing the structural model using PLS-SEM on valid empirical data (N = 400) showed that all ten hypotheses, comprising seven direct paths and three mediation pathways, one of which was a serial mediation pathway, were statistically supported, while the measurement model met the required reliability and validity criteria. Learning Impact, Student Engagement, and Enabling Conditions for Learning jointly explained 40.0% of the variance in Primary Education Quality, with Learning Impact emerging as the strongest proximal predictor.

The main contribution of this study is the development and empirical testing of a structural model that integrates enabling conditions for learning, teaching quality, student engagement, and learning impact into a single mechanistic framework for explaining the improvement of primary education quality. The study also provides empirical support for the serial mediation pathway linking Teaching Quality, Student Engagement, Learning Impact, and Primary Education Quality, which has not been extensively examined simultaneously in previous studies. The findings provide an empirical basis for

understanding how improvements in primary education quality can occur through interconnected learning mechanisms rather than through isolated educational factors. Further research involving additional empirical samples from teachers and primary school students is recommended to replicate and extend the model across different educational contexts, including through the incorporation of contextual variables such as school characteristics, students' socioeconomic backgrounds, and prevailing curriculum policies.

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