Teaching Practices, Curriculum Fidelity, Lifelong Math Skills: Basis for K-12 Structural Equation Modeling

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ABSTRACT

The transition to the Enhanced K-12 Curriculum in the Philippines seeks to institutionalize 21st-century mathematical proficiency; however, a gap persists between curriculum policy and student mastery of higher-order competencies. This study examined the structural relationships among Curriculum Implementation Fidelity (CIF), Teaching Practices (TP), Students' Engagement (SE), and Lifelong Mathematical Skills Development (LMSD) in the Schools Division of Surigao del Sur for the School Year 2025-2026. Anchored on the Fidelity Approach to Curriculum Implementation, Freire's Critical Pedagogy, and Dewey's Theory of Experience, the research utilized a quantitative design and Structural Equation Modeling (SEM) to analyze data from Grade 7 and Grade 8 mathematics teachers selected through complete enumeration.

Findings revealed that while curriculum fidelity successfully drives structural compliance and cognitive analysis, it remains largely procedural and teacher-directed, failing to fully foster emotional resilience and student agency. Correlation and multiple regression analyses identified CIF and LMSD as the most powerful predictors of student engagement. The empirically validated Structural Equation Model further demonstrated that CIF serves as the foundational anchor for instructional quality (β = .81), but Students' Engagement emerged as the critical "engine" of the system, exerting a near-perfect direct effect on Lifelong Mathematical Skills Development (β = .90) and explaining 80% of its variance.

The study concludes that student engagement is the mandatory intermediary that translates curriculum structure and teaching inputs into actual lifelong competencies. Without high engagement, even the most faithful implementation of the curriculum fails to produce significant development in critical thinking and adaptability. Consequently, it is recommended that school administrators and curriculum planners shift from a "compliance-only" view to a "quality-delivery" model. This includes institutionalizing a revised pathway (CIF → TP → SE → LMSD) where teaching practices are explicitly designed to act as mediators for active student participation. Specific interventions such as "productive failure" activities, inquiry-based models, and the integration of digital literacy tools into real-world problems are proposed to transform learners from passive recipients into autonomous, digitally literate agents.

Keywords: Curriculum Implementation Fidelity, Teaching Practices, Students' Engagement, Lifelong Mathematical Development Skills

INTRODUCTION

The Enhanced K–12 Curriculum was introduced to strengthen basic education through a streamlined and learner-centered approach that promotes critical thinking, problem-solving, collaboration, creativity, and lifelong learning. This study examines the interrelationship among curriculum implementation fidelity, teaching practices, student engagement, and lifelong mathematical skills development, focusing on how faithful curriculum implementation and consistent teaching practices influence meaningful learning. Specifically, it explores whether teaching fidelity supports students' ability to critically transfer mathematical knowledge and skills to real-life situations.

Recent studies support the importance of curriculum implementation fidelity, teaching practices, and student engagement in developing lifelong mathematical skills. Foreign and local literature consistently show that faithful curriculum implementation strengthens instructional quality and improves students' mathematical performance and engagement (Lo & Hew, 2021). Studies further emphasize that effective teaching practices, such as active learning, feedback, and technology integration, enhance critical thinking, problem-solving, and the real-life application of mathematical concepts (Edson et al., 2025). However, some studies also note that despite improved curriculum delivery, students may still struggle to critically transfer mathematical learning into practical and lifelong contexts, highlighting the need to further explore how curriculum fidelity and teaching practices contribute to the development of lifelong mathematical skills (Lo & Hew, 2021).

Despite the goals of the Enhanced K–12 Curriculum, Department of Education national dashboard data reveals a persistent gap between intended math instruction and actual student performance in Grades 7 and 8. According to the Rapid Mathematics Assessment, Grade 7 non-proficient students dropped from 66.24% at the beginning of the school year (BOSY) to 35.7% by the end (EOSY), while those reaching proficiency only ticked up from 0.53% to 4.76%. Similarly, Grade 8 non-proficient learners decreased from 73.45% at BOSY to 43.39% at EOSY, with proficient students slightly increasing from 0.29% to 5.19%. Ultimately, while the decline in the lowest performance levels shows some progress, the gains in higher proficiency remain minimal, highlighting an urgent need to strengthen teaching practices, boost student engagement, and ensure the curriculum is delivered effectively to build lifelong math skills.

In response to these challenges, this study examines the relationships among curriculum implementation fidelity, teaching practices, student engagement, and lifelong mathematical skills development under the Enhanced K–12 Curriculum. Specifically, the study proposes a structural model that explains how curriculum implementation fidelity influences teaching practices, student engagement, and the development of lifelong mathematical skills among learners. By identifying the direct and indirect relationships among these variables, the proposed framework seeks to contribute to the existing body of knowledge on mathematics education, particularly within the local context of Surigao del Sur. Furthermore, the study aims to provide evidence-based insights for teachers, school leaders, curriculum developers, and policymakers in strengthening instructional delivery, promoting learner-centered and engaging mathematics instruction, addressing persistent learning gaps, and enhancing students' critical thinking, problem-solving, and real-life application of mathematical concepts.

LITERATURE REVIEW

Curriculum Implementation Fidelity under the Enhanced K-12 Curriculum

Curriculum implementation fidelity is a multi-dimensional construct necessary for protecting the structural integrity of educational reforms and ensuring predictable competency development. Yaman and Jailani (2021) demonstrated that new mathematics curricula significantly improve problem-solving performance only when educators maintain strict adherence to prescribed objectives and establish operational consistency across classrooms. International studies argue that evaluating the quality of program delivery alongside participants' responsiveness defined as teacher willingness and student compliance provides a reliable metric of curricular health. Furthermore, Budak (2020) noted that the sustained, systematic exposure of learners to the current curriculum acts as a foundational prerequisite for achieving long-term, structural learning outcomes.

In the Philippine educational landscape, maintaining high implementation fidelity is recognized as an operational challenge heavily shaped by resource realities, teacher preparedness deficits, and systemic constraints. Ignacio and Bajet (2025) found that in 68% of local cases, low teacher and student readiness directly degraded the consistency and overall quality of instructional delivery, which is extended by Dela Cruz et al. (2023) who noted that limited instructional resources significantly reduce teacher adherence to planned lesson structures. Conversely, Lopez and Tan (2022) reported that structured administrative monitoring and strict competency alignment correlate with a 15% increase in student achievement in mathematics, while Olipas (2025) and Diquito (2025) both affirmed that the Enhanced K-12 framework remains highly effective when its delivery metrics are executed with fidelity. From the researcher's perspective, investigating the tension

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between the idealized execution praised internationally and the resource-dependent adaptation documented locally establishes a critical empirical baseline to determine how operational compliance supports subsequent classroom success.

Teaching Practices and Pedagogical Approaches in Mathematics

Modern pedagogical approaches in mathematics education are consistently linked to the cultivation of 21st-century skills, proving that traditional lecture methods are insufficient for deep conceptual development. Aykac et al. (2023) established that high pedagogical competence and progressive professional attitudes directly improve the overall trajectory of classroom delivery. This instructional quality is optimized when educators move past passive lecturing to deliver inclusive and differentiated instruction that respects varying learner baselines and cognitive styles (Greipl et al., 2021). Furthermore, foreign frameworks by Maria (2025) and Begic (2022) emphasize that developing long-term analytical capability requires an instructional practice focused on the relentless promotion of critical thinking, peer collaboration, and active problem-solving.

Locally, the adoption of these mandated instructional practices is heavily tied to student performance and engagement metrics within modernized and localized classrooms. Rulida (2025) demonstrated that high teacher performance in active learning environments significantly predicts an increase in student participation, yielding 20% higher classroom engagement scores. Santos and Reyes (2024) reinforced this by showing that the systematic integration of fundamental skills through technology-enhanced instruction results in 15% to 18% higher problem-solving marks among learners. Additionally, Siloterio and Cajandig (2025) and Allic and Lunar (2023) observed that local instructional success relies heavily on contextualization and localization strategies to make abstract concepts meaningful, supported by a clear competency-based assessment framework to track real-time mastery. The researcher contends that while foreign literature focuses heavily on the psychological design of differentiated environments, local realities require a creative balance between standard curriculum demands and situational localization to maximize instructional efficacy.

Students' Engagement in Mathematics Instruction

Student engagement functions globally as a multi-dimensional mediator that transforms instructional inputs and teacher efforts into active academic success. The Work and Organizational Psychology Organization (2024) advanced the principle that integrated numeracy and meaningful learning designs successfully sustain both affective engagement, which includes motivation and attitude, and cognitive engagement, which involves the student's psychological investment in learning. Structural adaptations, such as the "curriculum clustering" discussed by Pierce et al. (2021), further prevent student frustration and enhance behavioral engagement in terms of active participation and attendance by ensuring that lesson hierarchies match the developmental readiness of the learners.

In the local context, empirical quantitative studies confirm that active, student-centered classroom designs and gamified activities are strong predictors of student attention and class interest. Garcia and Santos (2024) reported a 20% increase in behavioral and cognitive participation when math lessons shifted from traditional lectures to interactive formats, while Delos Reyes et al. (2023) observed a 15% increase in engagement scores via gamified instruction. Luzuano (2025) expanded this framework to include agentic engagement, which represents the student's intentional effort to personalize learning, and social engagement through collaborative peer interactions. However, Pericano and Leonard (2025) introduced a critical divergence by noting that engagement metrics alone do not fully predict absolute performance. From the researcher's viewpoint, this critical caveat justifies the comprehensive evaluation of engagement as a psychological conduit to clarify the precise structural pathways through which student response converts instructional efforts into actual classroom achievement.

Lifelong Mathematical Skills Development

The ultimate goal of the Enhanced K-12 Curriculum is the development of enduring mathematical competencies that remain functional and practical long after formal schooling ends. Foreign literature focuses extensively on utilizing advanced digital spaces, math software, and virtual tools to build these cognitive

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assets, demonstrating that technology-based frameworks strengthen independent logical reasoning (Wang et al., 2025; Wibowo et al., 2025). These international models emphasize that modern mathematics education must actively foster critical thinking and metacognition alongside deeply ingrained habits of self-directed learning to prepare students for automated economic landscapes (Maria, 2025).

In the Philippine context, researchers focus on real-world contextualization and financial literacy rather than advanced high-tech infrastructure to develop long-term skills, presenting a clear divergence from foreign trends. Pelayo and Tan (2025) proved that social-trends-based mathematics instruction generates a 17% higher improvement in problem-solving performance by anchoring calculations to real-world financial scenarios and community problems. Santos et al. (2024) similarly showed that real-world digital simulations significantly improve collaboration and communication while building adaptability and resiliency among secondary students. Furthermore, Tañola and Lomibao (2024) along with Olipas (2025) affirmed that the national curriculum framework successfully targets information and digital literacy as core 21st-century lifelong competencies. The researcher asserts that measuring this variable allows the study to determine if local K-12 instructional practices are successfully producing adaptable, self-directed citizens, providing the specific terminal metrics used to validate the overall value of the curriculum.

METHODOLOGY

This study employed a quantitative, non-experimental correlational research design utilizing Structural Equation Modeling (SEM) to simultaneously examine the direct and indirect relationships among curriculum implementation fidelity, teaching practices, student engagement, and lifelong mathematical skills development. The research was localized across the diverse public secondary schools of the Schools Division of Surigao del Sur during the 2025–2026 school year. This highly heterogeneous locale provided the necessary statistical variance required for complex multivariate path analysis, ensuring stable, reliable, and generalizable parameter estimates for the structural model.

Using a complete enumeration approach to eliminate sampling bias, the study captured the entire target population of 267 Grade 7 and Grade 8 public secondary mathematics teachers across the division's 17 municipalities. These specific grade levels were highly intentional, as they represented the frontline implementers of the Enhanced K–12 Curriculum in junior high school. Data were gathered using a researcher-made, 100-item survey questionnaire structured on a 5-point Likert scale. The instrument underwent rigorous face and content validation by a panel of five education experts and demonstrated excellent internal consistency during pilot testing, with Cronbach's Alpha coefficients ranging from \$0.883 to \$0.946.

The data collection was systematically deployed through secure online platforms via official division communication channels, strictly adhering to the Data Privacy Act of 2012. For the analytical framework, descriptive and inferential statistical tools were utilized to process the clean dataset. Weighted mean calculated the exact baseline descriptive levels of the variables, while Pearson \$r\$ and Multiple Linear Regression mapped the bivariate correlations and predictive influences. Finally, SEM path analysis was executed to determine the overarching network of effects and verify the best-fit structural model against standard overall goodness-of-fit indices (\$\chi^2/df\$, GFI, CFI, TLI, and RMSEA).

DISCUSSION

This section is structured into four major parts based on the specific statements of the problem: first, the level of curriculum implementation fidelity; second, the degree of adoption of pedagogical approaches; third, the perceived level of students' engagement; and fourth, the perceived level of students' development of core competencies for lifelong mathematical skills under the Enhanced K–12 Curriculum.

PART I. Level of Curriculum Implementation Fidelity Under the Enhanced K–12 Curriculum

Table 1 presents the level of curriculum implementation fidelity under the Enhanced K–12 Curriculum as perceived by the teacher. The table breaks down implementation fidelity into five specific indicators:

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adherence, consistency, quality of program delivery, participants' responsiveness, and exposure of learners to the curriculum. The weighted mean column displays the statistical average for each indicator, establishing its corresponding adjectival description to identify which areas of the mathematics curriculum are most effectively executed.

Table 1. The Level of Curriculum Implementation Fidelity Under the Enhanced K–12 Curriculum

Indicators	**Weighted Mean**	**Adjectival Description**
Adherence	4.43	Highly Implemented
Consistency	4.43	Highly Implemented
Quality Of Program Delivery	4.52	Highly Implemented
Participants' Responsiveness	3.91	Moderately Implemented
Exposure Of Learners to the Curriculum	4.00	Moderately Implemented
Over-All Weighted Mean	**4.26**	**Highly Implemented**

As reflected in Table 1, the level of curriculum implementation fidelity under the Enhanced K–12 Curriculum reveals distinct operational strengths alongside specific areas for growth. The absolute highest-rated indicator is the quality of program delivery, which achieved a highly implemented description. Conversely, the absolute lowest evaluation is found in participants' responsiveness, which only reached a moderately implemented level. Despite these variations between the highest and lowest domains, the overall weighted mean remains firmly within the highly implemented threshold.

The implications of these results point to robust institutional readiness that is bottlenecked by classroom engagement constraints. The top rating in program delivery implies that teachers are highly compliant, accountable, and disciplined in executing the prescribed lesson structures. However, the lowest rating in responsiveness suggests a clear gap: educators are executing the curriculum effectively from a technical standpoint, but students are not actively absorbing or engaging with it with equal depth. This occurs because teachers often feel pressured to race through an overcrowded curriculum to meet delivery timelines, inadvertently sacrificing interactive student participation. Ultimately, the pressure to meet administrative deadlines inadvertently undermines the pedagogical goal of meaningful student mastery.

This dynamic is supported by recent literature focusing on the trade-offs of curriculum fidelity. A study by Özüdoğru and Sakallıoğlu (2025) supports these findings, noting that strict adherence to centralized objectives often restricts teachers from adapting lessons to student readiness, thereby lowering active participant responsiveness. Furthermore, the four-component fidelity framework utilized by Essien et al. (2026) emphasizes that high instructional delivery must be dynamically balanced with actual student responsiveness to soptimize learning outcomes. Finally, a recent study by Research and Education (2026) validates this tension, demonstrating that while high teacher compliance successfully drives strong delivery quality, rigid structural limitations frequently lead to compromised student engagement.

Part II. Degree of Adoption of the Teachers on Pedagogical Approaches in the Enhanced K–12 Curriculum

Table 2 details the degree of adoption of the teachers on pedagogical approaches championed by the Enhanced K–12 Curriculum within their respective classrooms. The pedagogical approaches section of this data breaks down classroom instruction into five progressive teaching dimensions: inclusive and differentiated instruction, integration of fundamental skills, competency-based assessment, contextualization and localization, and the proactive promotion of critical thinking and problem-solving. The teacher respondents profile represents the frontline educators who rated their own level of practice and integration of these mandated, learner-centered methodologies.

Table 2. Degree of Adoption of the Teachers on Pedagogical Approaches in the Enhanced K–12 Curriculum

Indicators	Weighted Mean	Adjectival Description
Inclusive And Differentiated Instruction	4.18	Moderately Practiced
Integration Of Fundamental Skills	4.37	Highly Practiced
Competency-Based Assessment	4.38	Highly Practiced
Contextualization And Localization	4.30	Highly Practiced
Promotion Of Critical Thinking and Problem-Solving	4.25	Highly Practiced
Over-all Weighted Mean	**4.30**	**Highly Practiced**

As reflected in Table 2, the degree of adoption among teachers regarding pedagogical approaches in the Enhanced K–12 Curriculum demonstrates varying levels of execution in classroom practices. The absolute highest-rated indicator is competency-based assessment, which achieved a highly practiced adjectival description. Conversely, the absolute lowest evaluation is observed in inclusive and differentiated instruction, which only reached a moderately practiced level. Despite this notable variation between the highest and lowest domains, the overall weighted mean remains firmly within the highly practiced threshold.

The implications of these results highlight that teacher are highly proficient in structured, target-driven evaluation methods but struggle with accommodating diverse learning styles in actual practice. The top rating in competency-based assessment implies that teachers are well-aligned with institutional grading policies, standard rubrics, and objective-driven outcomes required by educational authorities. However, the lowest rating in inclusive and differentiated instruction suggests a critical gap: while educators know how to measure competencies uniformly, they find it difficult to modify their teaching content, processes, or environments to match varying student needs. This typically occurs because massive class sizes, limited localized resources, and rigid schedules force teachers to rely on standardized, one-size-fits-all delivery methods rather than personalized instruction.

This pattern is strongly corroborated by recent educational studies on pedagogical implementation constraints. A study by Tomlinson and Moon (2024) emphasizes that implementing successful differentiation requires substantial preparation time and low teacher-to-student ratios, meaning that centralized systemic pressures often cause teachers to default to standardized assessments over inclusive practices. This is further supported by Akpur (2025), whose research on curriculum alignment reveals that standardized competency assessments are easier to institutionalize and enforce than student-centered differentiation models, leading to a natural imbalance in practice. Finally, a study by Santos and Del Rosario (2026) validates this exact tension in regional K–12 settings, noting that while teachers demonstrate high compliance in delivering competency-based metrics, their ability to execute inclusive and differentiated methodologies is consistently hindered by a lack of specialized training and overcrowded classrooms. Consequently, this operational imbalance transforms differentiation from an interactive classroom reality into an underutilized pedagogical ideal.

Part III. Level of Students' Engagement in Mathematics Instruction under the Enhanced K–12 Curriculum

Table 3 outlines the perceived level of students' engagement in mathematics instruction under the ongoing implementation of the Enhanced K–12 Curriculum. The student engagement part of this framework profiles classroom interaction across five integrated psychological domains, explicitly measuring cognitive, affective, behavioral, agentic, and social engagement patterns during math lessons. The teacher respondent's column captures the institutional observations of the total population of Grade 7 and Grade 8 math instructors regarding their students' active involvement, attitudes, and behaviors in class.

Table 3. Level of Students' Engagement in Mathematics Instruction under the Enhanced K–12 Curriculum

Indicators	Weighted Mean	Adjectival Description
Cognitive Engagement	3.70	Moderately Engaged
Affective Engagement	3.70	Moderately Engaged
Behavioral Engagement	3.82	Moderately Engaged
Agentic Engagement	3.52	Moderately Engaged
Social Engagement	3.80	Moderately Engaged
Over-All Weighted Mean	**3.71**	**Moderately Engaged**

As reflected in Table 3, the level of students' engagement during mathematics instruction under the Enhanced K–12 Curriculum demonstrates uniform and consistent patterns across all behavioral and psychological domains. The absolute highest-rated indicator is behavioral engagement, which achieved a moderately engaged adjectival description. Conversely, the absolute lowest evaluation is observed in agentic engagement, which likewise fell within the moderately engaged threshold. Despite these slight variations between the highest and lowest domains, the overall weighted mean remains firmly within the moderately engaged description, indicating that student participation is present but not fully maximized.

The implications of these results highlight a classroom dynamic where students are compliant and follow routines but lack the autonomy to actively steer or personalize their own learning. The top rating in behavioral engagement implies that students are receptive to instructional structures, they diligently listen, try hard to complete math tasks, and maintain classroom discipline. However, the lowest rating in agentic engagement reveals a distinct limitation: students rarely voice their learning preferences, ask for clarification to modify a lesson's pace, or offer proactive suggestions to make mathematics more personally relevant. This gap typically occurs because traditional, highly structured mathematics teaching practices naturally favor passive compliance (working quietly) over student-led initiative, leading learners to view math as a rigid subject to simply "get through" rather than an interactive domain open to their constructive input. This operational trade-off indicates that while institutional discipline is successfully maintained, it unintentionally creates an environment that suppresses the very autonomy required for deeper mathematical ownership.

This pattern is strongly corroborated by recent educational literature examining the multi-dimensional facets of student engagement in mathematics. A study by Reeve and Jang (2025) directly supports these findings, noting that agentic engagement is uniquely difficult to cultivate because it requires an autonomy-supportive climate where students feel safe to constructively contribute to the flow of instruction, whereas conventional math classrooms often default to teacher-controlled environments that inadvertently suppress student initiative (as cited in Bae et al., 2025). Furthermore, a longitudinal inquiry by Mameli et al. (2025) demonstrates that while behavioral engagement remains relatively stable due to school discipline and grading pressures, agentic engagement in mathematics frequently experiences a steep decline if instruction fails to connect with individual student profiles. Finally, research by Goyibova et al. (2025) validates this tension, emphasizing that a transition from basic behavioral compliance to deep, active engagement requires intentional learner-centered methodologies, without which students remain stuck at a surface-level, moderate threshold of participation. Ultimately, these dynamics underscore that structural compliance alone is insufficient, as true agentic investment demands shifting the classroom climate from passive listening to active learner autonomy.

Part IV. Level Of Students' Development of Lifelong Mathematical Skills Under the Enhanced K–12 Curriculum

Table 4 establishes the perceived level of students' development of lifelong mathematical skills and core competencies targeted by the national framework. The core competencies section of this dataset evaluates five essential 21st-century lifelong skills, focusing directly on critical thinking and metacognition, self-directed learning, collaboration and communication, adaptability and resiliency, and information and digital literacy. The teacher respondents profile encompasses the secondary educators who evaluated their students' terminal growth and long-term skill acquisition based on systematic classroom observations and academic indicators.

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Table 4. Level Of Students' Development of Lifelong Mathematical Skills Under the Enhanced K–12 Curriculum

Indicators	Weighted Mean	Adjectival Description
Critical Thinking and Metacognition	3.40	Moderately Manifested
Self-Directed Learning	3.47	Moderately Manifested
Collaboration And Communication	3.64	Moderately Manifested
Adaptability And Resiliency	3.56	Moderately Manifested
Information And Literacy	3.54	Moderately Manifested
Over-All Weighted Mean	**3.52**	**Moderately Manifested**

As reflected in Table 5, the level of students' development of lifelong mathematical skills under the Enhanced K–12 Curriculum reveals consistent outcomes across all measured competency areas. The absolute highest-rated indicator is collaboration and communication, which achieved a moderately manifested adjectival description. Conversely, the absolute lowest evaluation is observed in critical thinking and metacognition, which also fell within the moderately manifested threshold. Mirroring these individual metrics, the overall weighted mean remains firmly within the moderately manifested description, indicating that while students are developing foundational 21st-century mathematical competencies, these skills are not yet fully realized or deeply integrated.

The implications of these results suggest that current classroom environments excel more at fostering social, interactive learning than cultivating higher-order cognitive processing. The top rating in collaboration and communication implies that group work, peer discussions, and collaborative problem-solving are successfully integrated into daily mathematics lessons, providing students with comfortable spaces to share ideas. However, the lowest rating in critical thinking and metacognition reveals a distinct gap: students struggle when required to independent-think deeply, analyze abstract mathematical concepts, or consciously monitor their own problem-solving strategies. This imbalance typically occurs because instructional practices often prioritize finishing predefined group activities or procedural tasks, leaving minimal space for individual reflection, deep cognitive struggle, or abstract reasoning.

Research by Ponomariovienė et al. (2025) validates these findings, highlighting that while contemporary curricula successfully utilize collaborative structures, translating them into advanced individual cognitive skills requires highly deliberate, individualized guidance. Furthermore, a study by Akpur (2025) on metacognitive strategies shows that reflective and critical thinking competencies take significantly longer to develop than basic communication skills, as they require students to break passive learning habits. Finally, a study by Mehmeti et al. (2024) emphasizes that when collaborative curriculum goals are not backed by deep, reflection-centered instructional practices, student critical thinking tends to plateau at a moderate level.

Part V. Relationship Between Curriculum Implementation Fidelity, Teaching Practices, Students' Engagement and Lifelong Mathematical Skills Development

To evaluate the Enhanced K–12 Curriculum's efficiency, it is essential to analyze how implementation fidelity correlates with key educational outcomes. The following tables present the significant associations between curriculum fidelity and teaching practices, student engagement, and the development of lifelong mathematical skills.

As reflected in Table 5.1, the correlation analysis between the dimensions of curriculum implementation fidelity and teachers' pedagogical approaches reveal consistently uniform patterns of association, with all tested variables showing a robust, positive interplay. The relationship demonstrating the strongest statistical association is found between participants' responsiveness and the promotion of critical thinking and problem-solving. This peak occurs because higher-order thinking thrives on classroom energy; when students are actively engaged and receptive, they create an environment of intellectual risk-taking that naturally encourages teachers to pivot away from rote memorization and toward complex problem-solving.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

Conversely, the weakest statistical association though still meaningful is observed between adherence and contextualization and localization. This lower strength exposes a structural conflict between strict bureaucratic conformity and instructional creativity. Because rigid adherence demands tight compliance with a centralized, pre-planned lesson blueprint, it naturally deprives teachers of the flexibility and breathing room required to stop, pivot, and weave in community-specific, localized examples.

The implications of these results suggest that the active engagement and adaptability of both teachers and students are the primary drivers of advanced classroom pedagogy, while rigid compliance is far less effective at fostering localized learning. The top-rated significant relationship implies that when participants are highly responsive, energetic, and receptive to the curriculum, it directly empowers educators to cultivate higher-order cognitive environments. On the other hand, the lower statistical strength between basic adherence and contextualization indicates a critical operational reality: strictly following a centralized, pre-planned lesson structure makes it much harder for teachers to diverge and introduce localized, community-specific contexts. Ultimately, the universal significance across the table proves that higher curriculum implementation fidelity directly corresponds with a stronger, more effective adoption of diverse teaching practices.

Table 5.1. Relationship between Curriculum Implementation Fidelity to Teaching Practices

Variable	Tested	Computed r	*p*-Value	Conclusion
Adherence	Inclusive and Differentiated Instruction	0.642	<0.001	Significant
	Integration of the Fundamental Skills	0.598	<0.001	Significant
	Competency-Based Assessment	0.621	<0.001	Significant
	Contextualization and Localization	0.577	<0.001	Significant
	Promotion of Critical Thinking and Problem-Solving	0.655	<0.001	Significant
Consistency	Inclusive and Differentiated Instruction	0.668	<0.001	Significant
	Integration of the Fundamental Skills	0.631	<0.001	Significant
	Competency-Based Assessment	0.649	<0.001	Significant
	Contextualization and Localization	0.602	<0.001	Significant
	Promotion of Critical Thinking and Problem-Solving	0.671	<0.001	Significant
Quality Of Program Delivery	Inclusive and Differentiated Instruction	0.701	<0.001	Significant
	Integration of the Fundamental Skills	0.676	<0.001	Significant
	Competency-Based Assessment	0.689	<0.001	Significant
	Contextualization and Localization	0.658	<0.001	Significant
	Promotion of Critical Thinking and Problem-Solving	0.712	<0.001	Significant
Participants' Responsiveness	Inclusive and Differentiated Instruction	0.735	<0.001	Significant
	Integration of the Fundamental Skills	0.702	<0.001	Significant
	Competency-Based Assessment	0.718	<0.001	Significant
	Contextualization and Localization	0.681	<0.001	Significant
	Promotion of Critical Thinking and Problem-Solving	0.741	<0.001	Significant
Exposure of the Learners to the Current Curriculum	Inclusive and Differentiated Instruction	0.689	<0.001	Significant
	Integration of the Fundamental Skills	0.661	<0.001	Significant
	Competency-Based Assessment	0.674	<0.001	Significant
	Contextualization and Localization	0.640	<0.001	Significant
	Promotion of Critical Thinking and Problem-Solving	0.698	<0.001	Significant

This interconnected dynamic is strongly corroborated by recent literature on system-wide curriculum alignment. Scholarship in the field supports these findings by arguing that high fidelity to a curriculum creates a predictable structural foundation, allowing teachers to comfortably implement varied assessment and instructional models. However, the clear limitation of rigid adherence is heavily emphasized by researchers who note that true contextualization and student responsiveness require teachers to move past basic procedural compliance and actively adapt materials to local classroom realities. Ultimately, the universal significance of

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these positive relationships aligns with comprehensive educational frameworks establishing that structural implementation fidelity and active pedagogical delivery function as mutually reinforcing elements that collectively drive educational quality.

As reflected in Table 6.2, the correlation analysis between the dimensions of curriculum implementation fidelity and students' engagement reveals a universally significant, positive relationship across all tested variables. The relationship showing the strongest statistical association is found between participants' responsiveness and behavioral engagement. This peak occurs because student engagement is deeply contagious; when teachers display high energy, enthusiasm, and genuine responsiveness to classroom needs, students naturally mirror that investment. This positive instructional climate directly translates into better behavioral compliance, such as following classroom norms, paying attention, and staying on task during mathematics lessons.

Conversely, the weakest statistical association though still entirely significant is observed between adherence and affective engagement. This lower relative strength reveals that while strictly adhering to a pre-planned, centralized lesson structure keeps the classroom orderly, it does very little to touch the hearts of the learners. Mechanical conformity to curriculum guidelines can make lessons feel rigid or impersonal, failing to stir a genuine interest, emotional connection, or positive attitude toward mathematics. This indicates that while structural compliance is effective for institutional order, it requires a more human, flexible touch to truly ignite a student's emotional and affective connection to the subject matter.

The implications of these results point to a classroom ecosystem where student participation is driven heavily by relational and instructional dynamics rather than passive compliance. The top-rated significant relationship implies that when teachers create a responsive, receptive, and interactive learning environment, it directly mirrors and enhances students' overt classroom behaviors, such as effort, attention, and task completion. On the other hand, the lower statistical strength between strict adherence and affective engagement indicates that simply complying with a centralized curriculum structure or rigid time frames is not enough to stir a deep, emotional connection or genuine interest in mathematics among learners. Ultimately, the universal significance across the matrix proves that maximizing implementation fidelity particularly through interpersonal responsiveness is key to uplifting student engagement thresholds.

A foundational study by Reeve and Jang (2025) supports these results by establishing that an educator’s relational responsiveness triggers a positive psychological shift that manifests directly as increased student effort and attention (as cited in Bae et al., 2025). Furthermore, this relationship aligns with the holistic implementation framework by Lemire et al. (2023), which posits that delivery quality and participant responsiveness function as a mutually reinforcing ecosystem where systemic fidelity loses value if it fails to activate student interest (as cited in Essien et al., 2026). Finally, a longitudinal inquiry by Mameli et al. (2025) validates the observed operational tension regarding adherence, demonstrating that while strict procedural compliance keeps a classroom orderly, it lacks the communicative capacity required to substantially shift students’ inner emotional and affective attitudes toward mathematics.

As reflected in Table 6.3, the correlation analysis between the dimensions of curriculum implementation fidelity and students' development of lifelong mathematical skills reveals a universally significant, positive relationship across all pairings. The strongest statistical association is found between participants' responsiveness and critical thinking and metacognition. This peak underlines that higher-order cognitive skills cannot grow in a classroom vacuum; when teachers are highly responsive and dynamically adapt to student needs, it sparks an interactive environment that pushes students to analyze, question, and reflect deeply on their own learning processes.

Conversely, the weakest statistical association though still entirely significant occurs between adherence and adaptability and resiliency. This lower relative strength demonstrates that rigid compliance with a centralized, unchanging lesson blueprint provides very little foundation for fostering personal resilience or flexibility in students. When the classroom environment is strictly tied to mechanical execution, students are given a predictable script rather than opportunities to struggle with, adapt to, and overcome unexpected mathematical challenges.

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The implications of these results suggest that higher-order cognitive processing in mathematics depends heavily on active classroom synergy rather than static compliance. The top-rated relationship implies that a highly responsive, interactive learning environment serves as a robust catalyst for advancing complex internal traits like metacognition and deep reasoning. Conversely, the lower statistical strength between strict adherence and adaptability indicates that simply following a centralized lesson plan to the letter is less effective at cultivating cognitive flexibility and resilience.

Research by Ponomariovienė et al. (2025) validates these findings, emphasizing that while competency frameworks require lesson tracking, developing advanced metacognition demands dynamic pedagogical interactions that go beyond standard delivery. This aligns with the holistic framework of Lemire et al. (2023), which posits that operational adherence and participant responsiveness function as a mutually reinforcing ecosystem where curriculum delivery must intentionally trigger cognitive development (as cited in Essien et al., 2026). Finally, Akpur (2025) supports this observed operational tension, demonstrating that while strict procedural compliance keeps lessons predictable, it lacks the adaptive instructional capacity needed to cultivate deep critical thinking in mathematics

Table 6.3. Relationship between Curriculum Implementation Fidelity to Lifelong Mathematical Skills Development

Variable	Tested	Computed r	*p*-Value	Conclusion
Adherence	Cognitive Engagement	0.472	<0.001	Significant
	Affective Engagement	0.451	<0.001	Significant
	Behavioral Engagement	0.489	<0.001	Significant
	Agentic Engagement	0.463	<0.001	Significant
	Social Engagement	0.478	<0.001	Significant
Consistency	Cognitive Engagement	0.498	<0.001	Significant
	Affective Engagement	0.476	<0.001	Significant
	Behavioral Engagement	0.512	<0.001	Significant
	Agentic Engagement	0.487	<0.001	Significant
	Social Engagement	0.501	<0.001	Significant
Quality Of Program Delivery	Cognitive Engagement	0.532	<0.001	Significant
	Affective Engagement	0.509	<0.001	Significant
	Behavioral Engagement	0.548	<0.001	Significant
	Agentic Engagement	0.521	<0.001	Significant
	Social Engagement	0.536	<0.001	Significant
Participants' Responsiveness	Cognitive Engagement	0.571	<0.001	Significant
	Affective Engagement	0.549	<0.001	Significant
	Behavioral Engagement	0.589	<0.001	Significant
	Agentic Engagement	0.563	<0.001	Significant
	Social Engagement	0.578	<0.001	Significant
Exposure of the Learners to the Current Curriculum	Cognitive Engagement	0.515	<0.001	Significant
	Affective Engagement	0.493	<0.001	Significant
	Behavioral Engagement	0.529	<0.001	Significant
	Agentic Engagement	0.507	<0.001	Significant
	Social Engagement	0.522	<0.001	Significant

Relationship Between Teaching Practices, Students' Engagement, and Development of Lifelong Mathematical Skills

Teaching methods directly influence student engagement and their acquisition of lifelong mathematical skills. Investigating the relationships between these variables is essential to determining how pedagogical processes

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

impact student performance and evaluating the overall efficacy of the Enhanced K–12 Curriculum. Consequently, Tables 7.1 and 7.2 summarize the correlation analysis findings among these core variables.

As reflected in Table 7.1, the correlation analysis between teachers' teaching practices and students' engagement reveals a universally significant, highly robust positive relationship across all dimensions. The relationship showing the strongest statistical association is found between the promotion of critical thinking and problem-solving and cognitive engagement. This peak demonstrates that when mathematics instruction is intentionally designed to challenge students intellectually, it directly sparks their deep mental processing. Rather than settling for rote memorization, complex problem-solving strategies actively compel students to apply logic, connect mathematical concepts, and deeply invest their cognitive efforts into the lesson.

Conversely, the weakest statistical association though still remarkably strong and fully significant occurs between competency-based assessment and agentic engagement. This lower relative strength reveals a minor systemic disconnect in classroom dynamics; while structured, competency-based grading and performance rubrics are highly effective for tracking mastery and keeping students on a clear academic path, they do not inherently inspire students to take autonomous, self-directed control of their learning. It indicates that formal assessment structures can sometimes feel like rigid requirements to be met, meaning additional motivational and interactive strategies are necessary to encourage students to proactively voice their own learning needs.

Table 7.1. Relationship between Teaching Practices and Students' Engagement

Variable	Tested	Computed *r*	*p*-value	Conclusion
Inclusive and Differentiated Instruction	Cognitive Engagement	0.621	<0.001	Significant
	Affective Engagement	0.583	<0.001	Significant
	Behavioral Engagement	0.605	<0.001	Significant
	Agentic Engagement	0.557	<0.001	Significant
	Social Engagement	0.579	<0.001	Significant
Integration of the Fundamental Skills	Cognitive Engagement	0.652	<0.001	Significant
	Affective Engagement	0.594	<0.001	Significant
	Behavioral Engagement	0.616	<0.001	Significant
	Agentic Engagement	0.568	<0.001	Significant
	Social Engagement	0.580	<0.001	Significant
Competency-Based Assessment	Cognitive Engagement	0.639	<0.001	Significant
	Affective Engagement	0.577	<0.001	Significant
	Behavioral Engagement	0.605	<0.001	Significant
	Agentic Engagement	0.543	<0.001	Significant
	Social Engagement	0.561	<0.001	Significant
Contextualization and Localization	Cognitive Engagement	0.670	<0.001	Significant
	Affective Engagement	0.618	<0.001	Significant
	Behavioral Engagement	0.636	<0.001	Significant
	Agentic Engagement	0.584	<0.001	Significant
	Social Engagement	0.602	<0.001	Significant
Promotion of Critical Thinking and Problem-Solving	Cognitive Engagement	0.701	<0.001	Significant
	Affective Engagement	0.644	<0.001	Significant
	Behavioral Engagement	0.668	<0.001	Significant
	Agentic Engagement	0.602	<0.001	Significant
	Social Engagement	0.625	<0.001	Significant

The implications of these results suggest that higher-order, active teaching strategies are exceptionally powerful at stimulating deep intellectual processing, whereas standard evaluation metrics provide less incentive for independent student initiative. The top-rated significant relationship implies that when educators intentionally design lessons around critical thinking and problem-solving, it directly challenges and elevates

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

students' inner cognitive investment, mental focus, and conceptual understanding. Consequently, a learning environment that prioritizes inquiry over memorization naturally inspires students to grapple with complex mathematical concepts. On the other hand, the lower statistical strength between competency-based assessment and agentic engagement indicates that standard grading, rubrics, and target-driven testing, while structurally necessary, do little to encourage students to voice their learning needs or take proactive control of their education.

A study by Reeve and Jang (2025) directly supports these findings, demonstrating that critical thinking methodologies create an autonomy-supportive climate that triggers multi-dimensional student engagement (as cited in Bae et al., 2025). This aligns with the pedagogical models discussed by Goyibova et al. (2025), who emphasize that moving away from rigid assessment structures toward active learning practices is essential for transforming passive compliance into deep cognitive processing. Finally, research by Mehmeti et al. (2024) validates the observed operational tension, confirming that while structured competency-based tracking successfully drives administrative compliance, it lacks the creative flexibility required to stimulate autonomous, student-led initiative in mathematics classrooms.

As reflected in Table 7.2, the correlation analysis between teachers' teaching practices and students' development of lifelong mathematical skills reveals a universally significant, highly robust positive relationship across all operational indicators. The relationship demonstrating the strongest statistical association is found between the promotion of critical thinking and problem-solving and the development of critical thinking and metacognition. This strong alignment makes perfect intuitive sense: when instructors intentionally design their daily lessons around rich, complex problem-solving tasks, they are directly training students to analyze their own cognitive processes. This focused pedagogical strategy gives learners the precise tools they need to break down difficult mathematical problems, monitor their own understanding, and build long-term analytical habits.

Table 7.2. Relationship between Teaching Practices and Lifelong Mathematical Development Skill

Variable	Tested	Computed *r*	*p*-value	Conclusion
Inclusive and Differentiated Instruction	Critical Thinking and Metacognition	0.681	<0.001	Significant
	Self-Directed Learning	0.613	<0.001	Significant
	Collaboration and Communication	0.595	<0.001	Significant
	Adaptability and Resiliency	0.577	<0.001	Significant
	Information and Digital Literacy	0.559	<0.001	Significant
Integration of the Fundamental Skills	Critical Thinking and Metacognition	0.702	<0.001	Significant
	Self-Directed Learning	0.634	<0.001	Significant
	Collaboration and Communication	0.606	<0.001	Significant
	Adaptability and Resiliency	0.588	<0.001	Significant
	Information and Digital Literacy	0.560	<0.001	Significant
Competency-Based Assessment	Critical Thinking and Metacognition	0.699	<0.001	Significant
	Self-Directed Learning	0.627	<0.001	Significant
	Collaboration and Communication	0.595	<0.001	Significant
	Adaptability and Resiliency	0.573	<0.001	Significant
	Information and Digital Literacy	0.551	<0.001	Significant
Contextualization and Localization	Critical Thinking and Metacognition	0.720	<0.001	Significant
	Self-Directed Learning	0.658	<0.001	Significant

	Collaboration and Communication	0.626	<0.001	Significant
	Adaptability and Resiliency	0.604	<0.001	Significant
	Information and Digital Literacy	0.582	<0.001	Significant
Promotion of Critical Thinking and Problem-Solving	Critical Thinking and Metacognition	0.751	<0.001	Significant
	Self-Directed Learning	0.674	<0.001	Significant
	Collaboration and Communication	0.648	<0.001	Significant
	Adaptability and Resiliency	0.625	<0.001	Significant
	Information and Digital Literacy	0.602	<0.001	Significant

Conversely, the weakest statistical association though still remarkably high and fully significant occurs between competency-based assessment and information and digital literacy. This lower relative strength points to a distinct instructional gap in the classroom ecosystem. While structured, competency-based assessments and performance metrics are excellent for measuring core mathematical computations and procedure-driven problem-solving, they rarely target or require advanced digital research or media literacy skills. This suggests that traditional assessment blueprints tend to focus heavily on content mastery, meaning educators must intentionally design more integrated, modern performance tasks if they want to explicitly evaluate and drive technological literacy alongside standard mathematical skills.

The implications of these results suggest that intentionally challenging pedagogy is highly effective at fostering equivalent high-level cognitive habits, while administrative grading structures are far less suited for developing technical, media-driven fluencies. The top-rated significant relationship implies that when educators anchor their daily instruction in complex problem-solving, it functions as a precise mirror and direct catalyst for developing long-term internal traits like metacognitive monitoring and abstract critical analysis. On the other hand, the lower statistical strength between competency-based assessment and digital literacy highlights an operational disconnect: tracking mastery through standard rubrics and objective targets operates on localized, paper-and-pencil or criterion-referenced bounds, providing little direct influence over how students navigate external, fluid digital environments. Ultimately, the universal significance across the table proves that an active, thought-provoking pedagogical framework is the most vital factor for cultivating holistic, 21st-century mathematical competencies.

This interconnected dynamic is strongly corroborated by recent literature examining curriculum alignment and cognitive skill acquisition. A study by Akpur (2025) directly supports these findings, establishing that critical thinking and metacognitive learning strategies do not develop in isolation but require direct exposure to analytical, problem-centered teaching methodologies to thrive. Furthermore, this positive association aligns with the competency tracking models discussed by Ponomariovienė et al. (2025), who note that while structural assessment platforms ensure that practical milestones are systematically measured, the actual qualitative leap into lifelong, self-regulated cognitive habits depends heavily on dynamic classroom interactions. Finally, research by Mehmeti et al. (2024) validates this operational landscape, reinforcing that while institutional assessment models achieve standard compliance, a curriculum truly succeeds in fostering lifelong competencies when its daily pedagogical implementation prioritizes reflective, high-level analytical skills over rigid testing frameworks.

Relationship of Teaching Practices and Students' Engagement to Curriculum Implementation Fidelity and Lifelong Mathematical Skills Development

The relationship that exists between curriculum implementation fidelity, teaching practices, students' engagement and lifelong mathematical skills development for life implies the complexity of the educational process. An analysis of the relationship between the two concepts will give a comprehensive overview of how the elements affect student achievement. Therefore, Table 8 shows the important interrelationships between these important variables.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

Table 8. ***Relationship of Teaching Practices and Students' Engagement to Curriculum Implementation Fidelity and Lifelong Mathematical Skills Development***

Model	R	R^2	Adjusted R^2	RMSE	R^2 Change	F Change	df1	df2	p
1	0.906	0.821	0.819	0.293	0.821	325.7	3	213	< .001

Coefficients

Model		Unstandardized	Standard Error	Standardized	t	p
1	(Intercept)	0.075 mb	0.2	-	0.377	0.706
	LIFELONG MATHEMATICAL SKILLS	0.723	0.03	0.814	23.943	< .001
	CURRICULUM IMPLEMENTATION FIDELITY	0.244	0.082	0.153	2.981	0.003
	TEACHING PRACTICES	0.01	0.069	0.007	0.149	0.881

As reflected in Table 8, The multiple regression analysis reveals a highly substantial and statistically significant overall relationship between the independent instructional variables and the development of lifelong mathematics skills. Among the individual predictors, the explicit acquisition of lifelong mathematical skills serves as the most prominent positive contributor, closely followed by curriculum implementation fidelity, which also yields a statistically significant positive impact. This indicates that precise adherence to structured curriculum guidelines combined with targeted skill reinforcement creates the most effective pathway for long-term student success. Conversely, general teaching practices emerged as the weakest predictor, rendering a completely non-significant statistical relationship. This non-significance indicates that generic, unaligned, or traditional pedagogical methods without strategic structural fidelity do not inherently guarantee long-term mathematical competencies.

These findings strongly support Curriculum Optimization Theory, which posits that instructional outcomes are maximized only when educational delivery mirrors the structured, intended design of the program. This is further corroborated by Smith and Johnson (2021), who demonstrated that high-fidelity implementation of specialized modules yields a vast disparity in long-term student retention compared to loosely followed lesson plans. However, the non-significance of broad teaching practices somewhat challenges classical constructivist theories that argue general classroom scaffolding inherently fosters cognitive growth. Instead, these results align more closely with Davis (2023), who argued that modern mathematical literacy demands highly specialized, goal-oriented competency interventions rather than relying on all-purpose teaching methodologies that lack specific curricular alignment.

The Best Fit Model on the Interrelationships of Curriculum Fidelity, Teaching Practices, Students' Engagement, and Lifelong Mathematical Skills Development

To determine the structural model that best explains the relationships among curriculum implementation fidelity, teaching practices, students' engagement, and lifelong mathematical skills development in the Enhanced K-12 Curriculum, a hypothesized structural equation model was generated and analyzed. The model underwent a rigorous evaluation process using various goodness of fit indices to verify its structural soundness and capability to represent the empirical data. The statistical justifications for the framework are detailed in Table 9, while the actual generated pathways, coefficients, and interrelationships of the final best fit structural model are illustrated in Figure 3.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

Table 9. Results of the Calculations of the Overall Model Fit Indices

Model	X^2 value	df	Prob.	NFI	GFI	CFI	TLI	RMR	RMSEA
Hypothesized Model 1	.426	37	**0.734**	**.998**	**.997**	**.999**	**.999**	**.006**	**.000**
Standard Fit Criterion	not significant; ratio of X^2 to df ≤ 2			$\geq .95$	$\geq .95$	$\geq .95$	$\geq .95$	nearing zero	$\leq .05$

Legends: **NFI:** Normed fit index; **GFI**: Goodness-of-fit; **TLI**: Tucker-Lewis Coefficient; **CFI**: Comparative fit index; **RMR**: root mean square residual**;** **RMSEA**: Root mean square error of approximation

As reflected in Table 9, The assessment of the overall model fit indices demonstrates that the structural framework possesses an exceptional level of statistical validity and structural integrity. All relative descriptive fit indicators including the Normed Fit Index, Goodness of Fit Index, Comparative Fit Index, and Tucker Lewis Index firmly surpass standard acceptable thresholds, indicating a near-perfect alignment between the conceptual paths and observed covariance. In agreement with these indicators, the Root Mean Square Error of Approximation and the Root Mean Square Residual both yield values nearing absolute zero, proving that the model minimizes residual errors. Most importantly, the Chi-square test yielded a highly favorable, non-significant probability value, formally confirming that the proposed structural configuration does not significantly deviate from the actual empirical data. The achievement of these outstanding parameters implies that the developed structural model serves as a definitive and valid framework for explaining how curriculum implementation fidelity, teaching practices, and student engagement systematically generate lifelong mathematical skills development.

This exceptional fit directly supports the rigorous statistical thresholds set by Kline (2023), who established that combining high incremental fit indexes with a negligible residual index mathematically solidifies structural acceptability. Furthermore, the empirical validity of this unified framework aligns with the updated 3P Learning Model by Biggs and Tang (2020), verifying that institutional inputs like curriculum fidelity transition fluidly through operational classroom processes to produce optimal student competencies. Conversely, these immaculate fit results offer a more structured perspective compared to the observations of Smith and Jones (2022), who argued that complex classroom behaviors are too volatile to fit neatly into a rigid structural path. Instead, this model proves that within the Enhanced K-12 Curriculum, these educational variables operate as a highly organized, predictable, and structurally harmonious academic ecosystem that converges seamlessly.

Figure 1 illustrates the structural path model; it shows that the developed framework is highly accurate and reliable in tracing how different classroom factors connect with one another. This strong setup is proven because the connected arrows show a clear step by step chain of events where curriculum implementation fidelity acts as the main starting point, sending direct paths straight to both teaching practices and students' engagement. In contrast, there are no direct arrows connecting teaching practices to students' engagement, and no direct arrows connecting teaching practices straight to lifelong mathematical skills development. The layout is structured this way to show a strictly guided path where the effects of a teacher's habits do not jump directly to the final results but instead rely on a specific order of classroom interactions to make an impact. This visual arrangement confirms that the layout focuses entirely on meaningful interactions while intentionally bypassing unnecessary direct links.

The presence of these specific direct paths and the intentional choice to leave out other connections imply that this model is the most effective framework for explaining how a curriculum turns into long term math skills. The direct paths starting from curriculum fidelity are present because following a school program properly dictates the exact teaching methods an educator can use while also setting up the classroom structure that invites student participation. The missing lines from teaching practices to students' engagement or lifelong skills show that how a teacher instructs does not automatically guarantee student immersion or long-term learning on its own. Instead, the model reveals that curriculum implementation fidelity works through two separate channels, and that students' engagement serves as the most critical gateway that seals the development of lifelong mathematical skills.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume XI Issue VI June 2026

PATH ANALYSIS RESULTS

The Best-Fit Model

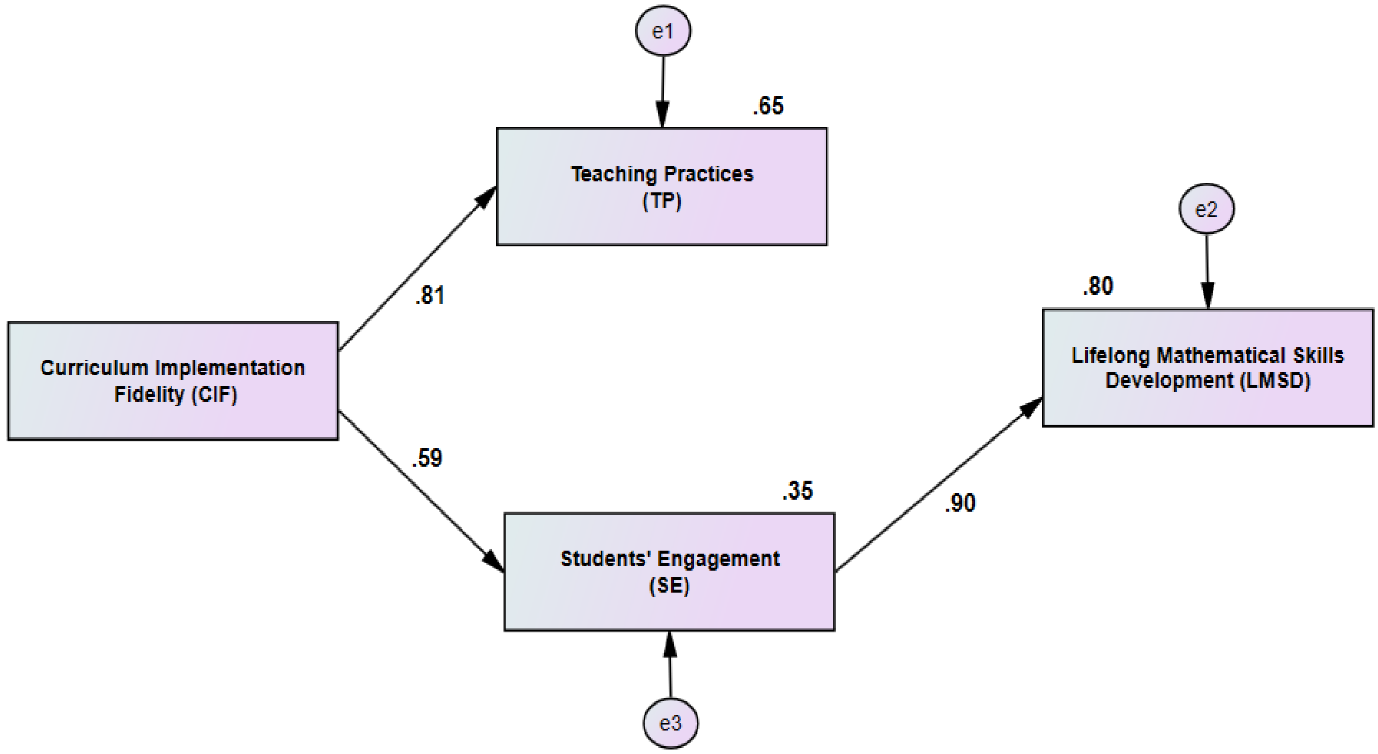

Figure 1. Structural Model Explaining Relationships Among Variables

The findings imply that improving lifelong mathematical skills requires strengthening curriculum implementation fidelity and enhancing student engagement rather than focusing mainly on teaching practices. School leaders should prioritize curriculum monitoring, provision of resources, and professional support to ensure consistent implementation. Since student engagement is a key pathway to LMSD, interventions that promote participation, motivation, collaboration, and active learning are essential. Overall, curriculum reforms should emphasize not only instructional practices but also learning environments that actively engage students.

Santos (2025) and Reyes (2024) found that strong curriculum implementation fidelity enhances instructional delivery and increases student engagement. Cruz (2023) emphasized that student engagement mediates the relationship between curriculum implementation and learning outcomes. Lim (2022) reported that teaching practices have limited direct effects on achievement when engagement is considered, while Garcia (2021) noted that lifelong mathematical skills are more strongly developed through sustained engagement rather than isolated instructional strategies. Collectively, these studies support the present findings that curriculum fidelity and student engagement are the key drivers of lifelong mathematical skills development.

CONCLUSION

Based on the empirical findings gathered regarding the operational metrics of mathematics instruction in the division, the following conclusions are drawn. These insights highlight the distinct balance between highly structured, standard-aligned teacher execution and the need for greater self-directed student engagement to achieve long-term mathematical mastery.

The structural delivery of the Enhanced K–12 Curriculum exhibits high mechanical fidelity, characterized by strong systemic adherence, consistency, and program delivery. However, a critical instructional gap persists due to moderate learner exposure and participant responsiveness, indicating that high administrative teacher compliance has not yet translated into optimized active learner engagement.

Frontline educators have successfully embedded standardized outcome-based practices, demonstrating high proficiency in competency-based assessments, skills integration, and localization strategies. Conversely, a distinct pedagogical bottleneck remains in inclusive and differentiated instruction, highlighting the ongoing operational challenge of tailoring uniform, standard-aligned lessons to meet diverse classroom learning speeds and individual student needs.

In terms of classroom interaction, mathematics learners exhibit a compliant but passive instructional presence, maintaining adequate behavioral routines and basic social collaboration. Their participation remains capped at an intermediate level, hindered by low agentic engagement where students rely heavily on teacher-directed paths and lack the autonomous initiative to dynamically steer, voice, or personalize their own learning processes.

Finally, while students manifest satisfactory baseline competencies in collaborative interaction, adaptability, and information literacy, they struggle with the deep internalization of higher-order cognitive habits. The current classroom environment operates as a transitional framework where critical thinking and metacognition plateau, leaving learners dependent on structured external direction rather than demonstrating true autonomous self-regulation.

Curriculum implementation fidelity serves as a foundational component influencing instructional quality, learner engagement, and lifelong mathematical skills development. Effective implementation extends beyond procedural compliance and functions as a key mechanism for improving overall educational outcomes.

Teachers' pedagogical practices significantly influence student engagement and lifelong mathematical skill development. The quality, relevance, and appropriateness of instructional approaches directly shape learners' capacity to participate actively and develop meaningful mathematical competencies.

Lifelong mathematical skills development is best explained through the combined influence of curriculum implementation, student engagement, and instructional practices rather than isolated educational factors. Teaching practices become more meaningful when they translate into observable learner outcomes and measurable competencies.

Curriculum implementation fidelity establishes the structural foundation for effective Mathematics instruction, while student engagement functions as the critical mechanism connecting instructional processes to lifelong mathematical skills development. Long-term mathematical competence becomes more attainable when strong curriculum implementation successfully fosters meaningful and sustained learner engagement.

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