From Fidelity to Flexibility: Developing the Adaptive Fidelity Framework (AFF) for Pedagogical Innovations in Teacher Education

Maria Leah Paola M. Estacio [1], Ronald M. Quileste [2*], Kathleen M. Morales [3]

[1, 2, 3] School of Education, Xavier University - Ateneo de Cagayan, Philippines

* rquileste@xu.edu.ph

Abstract

Global education systems face urgent challenges in scaling equitable, effective pedagogies, particularly in low- and middle-income countries (LMICs) where resource constraints and learning gaps persist. This mixed-methods study explored the Dynamic Learning Program (DLP), a student-centered pedagogy, in a Philippine private school, examining adherence, achievement, and stakeholder experiences. Through surveys, standardized tests, and interviews, the research revealed robust adherence but variable achievement, with stronger literacy outcomes than STEM. Teachers' adaptations, such as supplemental explanations, addressed conceptual challenges, highlighting the need for flexibility. Quantitative multiple regression analyses and qualitative themes converged to inform the Adaptive Fidelity Framework (AFF), a novel model balancing fidelity to core principles, teacher-led adaptation, and contextual moderators like resources and student readiness. Extending traditional fidelity models, the AFF prioritizes dynamic, context-responsive implementation, offering a scalable approach for teacher education and policy in LMICs and beyond. The study emphasizes teacher agency in navigating fidelity-adaptation tensions, contributing to global discourses on equitable reform. Implications include training teachers as adaptive implementers and designing monitoring systems that value contextual responsiveness. This Philippine case provides a blueprint for scaling innovations worldwide, advancing efforts to balance educational quality with equity.

Keywords: *Adaptive Fidelity Framework, Teacher Education, Student-Centered Learning, Implementation Science, Teacher Agency*

Introduction

Education systems worldwide confront the persistent challenge of delivering high-quality learning while addressing deep-seated inequities, a tension most pronounced in low- and middle-income countries (LMICs) where teacher shortages, limited resources, and systemic capacity gaps impede progress (Bremner et al., 2022; OECD, 2023a). Global assessments, such as the Programme for International Student Assessment (PISA), consistently reveal disparities, with many LMICs lagging in literacy, numeracy, and science compared to high-income nations (OECD, 2023a, 2023b, 2024). The COVID-19 pandemic exacerbated these inequities, disrupting schooling, widening learning gaps, and exposing the fragility of educational resilience across diverse contexts (Huber & Helm, 2020; Reich et al., 2020). These trends underscore the urgent need for pedagogical innovations that are both effective and adaptable to resource-constrained settings, ensuring equitable outcomes while maintaining quality (Hennessy et al., 2022; Kraft, Allensworth & Schwartz, 2021).

Student-centered pedagogies, grounded in constructivist principles, have emerged as a promising lever for educational transformation (Bhardwaj et al., 2025). By prioritizing active

engagement, critical thinking, and problem-solving, these approaches aim to foster learner autonomy and deeper understanding (Stains et al., 2017; Kang & Keinonen, 2018; The Brookings Institution, 2019). International evidence highlights their potential: inquiry-based learning in Finland improved science engagement (Kang & Keinonen, 2018). While active learning in U.S. universities enhanced critical thinking (Stains et al., 2017). However, prior studies reveal inconsistent outcomes across contexts. For example, found that student-centered programs in LMICs improved student attitudes but yielded mixed test score gains, often due to inadequate teacher training (Snilstveit et al, 2016). Similarly, reported variable STEM outcomes in high-income settings, attributing weak results to insufficient scaffolding for complex concepts (Andrews et al, 2019). In contrast, Haßler, Bennett, and Damani (2021) showed that student-centered approaches in Sub-Saharan Africa increased participation but struggled with resource constraints, unlike better-resourced U.S. programs (Baird & Pane, 2019). These studies highlight a critical research gap: limited empirical evidence on how fidelity and adaptation interact to influence standardized achievement outcomes in LMIC student-centered pedagogies, particularly in under-resourced settings like the Philippines. For educators and policymakers globally, the central question is how to implement innovations effectively while respecting local conditions to sustain impact (Sharathbabu, 2025).

Implementation fidelity, defined as the degree to which a program is enacted as designed, has long been viewed as a cornerstone of effective educational reform (Driessen et al., 2020; Lynch et al., 2019). High fidelity, in theory, preserves a program's core design, maximizing intended outcomes. Yet, empirical evidence paints a more complex picture: strict adherence does not always translate to improved learning, particularly in diverse contexts (Tolmatcheff et al., 2024). For instance, found that rigid fidelity to U.S. literacy interventions led to superficial task completion without deep understanding (Quinn & Kim, 2017). While Driessen- reported that inflexible STEM programs in LMICs failed to address student misconceptions due to lack of teacher adaptation (Willems et al, 2025). Conversely, demonstrated that flexible implementation in U.S. science curricula improved engagement when teachers adapted to student needs, unlike rigid models that faltered (Penuel et al, 2017). Such evidence suggests that fidelity alone is insufficient without adaptation to classroom realities, such as students' prior knowledge or teachers' expertise, a tension especially salient in teacher education where educators mediate policy and practice (Sharathbabu, 2025).

Recent scholarship advocates adaptive fidelity, a dynamic approach balancing adherence with teacher-led adaptations tailored to local needs (Jolles et al., 2024; Driessen-Willems et al., 2025). Unlike compliance-focused models adaptive fidelity empowers teachers as active agents (Lynch et al., 2019). As seen in study where African teachers' adaptations to student-centered programs improved outcomes despite resource limitations (Haßler et al, 2021). Similarly, found that U.K. teachers' flexible implementation of professional development programs enhanced classroom relevance (Sims & Fletcher-Wood, 2021). Contrasting with rigid models that ignored local contexts (Kizilcec et al., 2020). Adaptive fidelity is particularly relevant for LMICs, where resource constraints demand flexibility, but also aligns globally with calls for teacher agency and contextual responsiveness (Bremner et al., 2022; Hennessy et al., 2022).

The Dynamic Learning Program (DLP), developed in the Philippines, exemplifies a student-centered, cost-effective model designed to address teacher shortages and enhance learning outcomes in resource-constrained settings. DLP emphasizes structured independent learning activities, minimal lecturing, and cross-subject integration, aligning with constructivist and self-regulated learning (SRL) principles (de Leeuw et al., 2020; Xie et al., 2019). By positioning students as active constructors of knowledge, DLP mirrors global trends in student-centered

pedagogies, such as inquiry-based learning in Finland or project-based learning in the U.S. (Kang & Keinonen, 2018; The Brookings Institution, 2019). However, prior DLP studies rely heavily on anecdotal reports of engagement, lacking rigorous analyses of fidelity-outcome relationships using standardized assessments, unlike high-income studies of similar pedagogies (Escueta et al., 2020 ; Baird & Pane, 2019). For example, evaluation of U.S. personalized learning showed modest achievement gains with high fidelity (Baird & Pane's, 2019). While noted DLP's potential but lacked quantitative outcome data, limiting scalability insights for LMICs (Escueta et al, 2020). This gap underscores the need for systematic evaluation of DLP's implementation dynamics in resource-constrained settings.

This study addresses this gap by investigating DLP implementation in a Philippine private school through a mixed-methods design, integrating adherence surveys, standardized achievement tests in English, Mathematics, and Physics, and teacher-student interviews. Quantitative findings from multiple regression reveal high fidelity but weak achievement links, particularly in STEM, while qualitative insights highlight teacher adaptations addressing conceptual challenges, converging to inform the Adaptive Fidelity Framework (AFF). The AFF redefines fidelity as a dynamic interplay of adherence to core pedagogical principles, teacher-driven adaptation, and contextual moderators (e.g., resources, student readiness, curriculum demands). This study integrates three theoretical traditions that underpin the empirical analysis and AFF's development. First, constructivism posits that learners actively construct knowledge through exploration (Bhardwaj et al., 2025). Reflected in DLP's independent learning activities. Second, SRL theory underscores learners' ability to manage their motivation and cognition (Xie et al., 2019). Operationalized through DLP's structured tasks (de Leeuw et al., 2020). Third, implementation fidelity theory emphasizes adherence (Lynch et al., 2019). But critiques advocate adaptation (Driessen-Willems et al., 2025; Tolmatcheff et al., 2024). The AFF advances these by synthesizing fidelity, adaptation, and context into a dynamic, teacher-centered model, distinct from linear fidelity frameworks through its empirical validation via mixed-methods convergence.

To guide the investigation, this study examines the implementation of the Dynamic Learning Program (DLP) through a mixed-methods approach, addressing the following questions: (1) What is the level of adherence to DLP's components among teachers and students, as measured by adherence surveys? (2) What are the achievement outcomes of students in English, Mathematics, and Physics, as assessed by standardized diagnostic tests? (3) What is the relationship between adherence to DLP components and student achievement in these subject areas, analyzed through multiple regression? (4) How do teachers and students describe their experiences of implementing and engaging with DLP in their school context, explored through semi-structured interviews? (5) Based on the convergence of quantitative and qualitative findings, what conceptual framework best captures the dynamics of fidelity, adaptation, and context in DLP implementation, leading to the development of the Adaptive Fidelity Framework?

This study addresses a critical research gap by providing empirical evidence on fidelity-outcome relationships in an LMIC student-centered pedagogy, using standardized measures, unlike anecdotal DLP studies (Escueta et al., 2020). Compared to high-income research), which often focuses on well-resourced contexts, this study illuminates implementation dynamics in resource-constrained settings (Baird & Pane, 2019). The AFF's novelty lies in its dynamic fidelity model, validated through mixed-methods convergence, extending compliance-based frameworks by prioritizing teacher agency and contextual responsiveness (Lynch et al., 2019). Practically, the AFF informs teacher education by advocating training for adaptive implementation, equipping educators to balance fidelity with flexibility across diverse settings,

from LMICs to high-income nations. For policymakers, it supports designing context-responsive monitoring systems, aligning with UNESCO's Education 2030 Agenda and OECD guidelines (OECD, 2023). This Philippine case offers a globally relevant blueprint for scaling equitable, sustainable pedagogical reforms, contributing to international discourses on teacher education and implementation science.

Method

This study employed a mixed-methods design to investigate the implementation of the Dynamic Learning Program (DLP) in a Philippine private school, examining the relationship between adherence, student achievement, and teacher-student experiences. The methodology integrates quantitative descriptive-correlational and qualitative thematic analyses to address the research questions comprehensively, aligning with established approaches for studying educational innovations (Creswell & Creswell, 2018). This design was chosen to capture both measurable outcomes (e.g., adherence levels, achievement scores) and nuanced insights into implementation dynamics, offering a robust framework for developing the Adaptive Fidelity Framework (AFF) with global relevance.

Research Design

A concurrent mixed-methods design was utilized, combining quantitative and qualitative strands to provide a holistic understanding of DLP implementation. The quantitative component employed a descriptive-correlational approach to assess adherence to DLP components and its relationship with student achievement in English, Mathematics, and Physics, as measured by standardized diagnostic tests. Descriptive statistics summarized adherence levels, while correlational analyses explored associations with achievement outcomes. The qualitative component used thematic analysis to explore teacher and student experiences, providing context for quantitative findings and informing AFF development. This mixed-methods approach is well-suited for examining complex educational phenomena, as it triangulates data to enhance validity and depth (Creswell & Creswell, 2018). By integrating global implementation science perspectives, the design ensures findings are relevant to diverse educational contexts (Jolles et al., 2024; Tolmatcheff et al., 2023).

Research Context and Participants

The study was conducted at Rosevale School, a private secondary institution in Cagayan de Oro City, Philippines, where DLP has been institutionalized as the primary instructional model since 2018. Rosevale School serves a diverse student body of approximately 500 students, predominantly from middle-income families, with a curriculum aligned to national standards but enhanced by DLP's student-centered approach. The school's urban setting and stable infrastructure make it a suitable case for studying DLP implementation in a resource-constrained yet structured context, offering insights applicable to other LMIC settings (Bremner et al., 2022). Participants included 52 students and nine teachers, purposively selected to represent varied experiences with DLP. Students were drawn from multiple grade levels (Grades 7–10) across a four-year period (2021–2025), reflecting a mix of academic abilities and exposure to DLP instruction. The sample size was determined by the availability of students consistently enrolled in DLP-based classes, ensuring sufficient data for correlational analyses while maintaining feasibility within the single-school context. Teachers had 2–10 years of experience implementing DLP, with varying subject specializations (English, Mathematics, Physics). Purposive sampling ensured participants could provide rich insights into DLP's fidelity and adaptation, aligning with qualitative research standards (Braun & Clarke, 2006). Participation was voluntary, with

informed consent obtained from school administrators, teachers, students, and parents/guardians of minors. Ethical procedures adhered to international standards, ensuring confidentiality and participant rights, as detailed below.

Instruments

Two primary instruments were developed and administered to collect data: Adherence Surveys, Two tailored surveys—one for students (20 items) and one for teachers (22 items)— assessed adherence to DLP's core components: independent learning activities, peer collaboration, reduced lecture time, concept integration, and discipline/routine. Items were designed based on DLP's operational guidelines and aligned with constructivist and self-regulated learning principles (Xie et al., 2019). For example, a student survey item asked, "I complete DLP activity sheets independently before seeking teacher assistance" (1 = Never, 5 = Always). Responses were measured on a 5-point Likert-type scale, with higher scores indicating greater adherence. Content validity was established through review by three education experts familiar with DLP, and pilot testing with 15 students and five teachers yielded acceptable reliability (Cronbach's α = .78 for students, .82 for teachers). Surveys were administered in English, the medium of instruction, to ensure accessibility.

Standardized Diagnostic Tests, Student achievement was measured using standardized diagnostic tests from the Center for Educational Measurement (CEM), a nationally recognized testing body in the Philippines. Tests in English, Mathematics, and Physics were administered, each comprising 50–60 multiple-choice items designed to assess curriculum-aligned competencies. CEM tests are psychometrically rigorous, with established reliability (α > .85) and validity for national benchmarking (Escueta et al., 2020). Scores were reported as percentile ranks and stanines, enabling comparison with national norms. Tests were selected for their alignment with DLP's learning objectives and their widespread use in Philippine schools, ensuring relevance and comparability.

Data Collection Procedure

Data collection occurred in two phases over the 2024–2025 academic year, following sustained DLP implementation. In Phase 1, adherence surveys were distributed to students during scheduled class periods under researcher and teacher supervision, ensuring standardized administration. Teachers completed surveys individually during professional development sessions. Responses were anonymous, coded with identifiers to protect confidentiality, and collected within two weeks. In Phase 2, CEM diagnostic tests were administered under standardized conditions, following CEM protocols. Trained proctors oversaw testing to ensure uniformity, with sessions conducted in a controlled classroom environment. Test booklets and answer sheets were processed by CEM, and official score reports were provided to the school and researchers within one month. Qualitative data were collected concurrently through semi-structured interviews with 10 students and five teachers, selected based on survey responses to capture diverse perspectives. Interviews, conducted in English or Filipino (translated for analysis), lasted 30–45 minutes and explored experiences with DLP implementation, challenges, and adaptations. Audio recordings were transcribed verbatim and anonymized.

Data Analysis

Data analysis was conducted in two strands to address the research questions: **Quantitative Strand (RQ1–RQ3)**, Descriptive statistics (means, standard deviations) summarized adherence levels for each DLP component (independent learning activities, peer collaboration, reduced

lecture time, concept integration, discipline/routine), with cut-off ranges (e.g., M ≥ 4.0 = Adherent) guiding interpretation. Student achievement was analyzed using CEM-provided percentile ranks and stanines, categorized into performance levels (e.g., high average, below average). For RQ3, multiple linear regression analyses examined the relationship between adherence to DLP components and achievement in English, Mathematics, and Physics, with hierarchical regression testing moderation by teacher experience and student readiness. Statistical assumptions (normality, linearity, homoscedasticity, multicollinearity) were verified using Shapiro-Wilk tests, scatterplot inspections, and variance inflation factors (VIF < 5), with a .05 significance level. Analyses were conducted using SPSS version 26 (Creswell & Creswell, 2018).

Qualitative Strand (RQ4), Interview transcripts were analyzed using thematic analysis, following six-phase framework: familiarization, initial coding, theme generation, theme review, theme definition, and reporting. Two researchers independently coded transcripts, achieving 85% inter-coder agreement, with discrepancies resolved through discussion (Braun and Clarke's, 2006). NVivo software facilitated coding and theme organization. Three overarching themes (e.g., independence, concept mastery struggles, adaptation) emerged, supported by subthemes and illustrative quotes, presented in a thematic table per APA 7th standards. **Integration (RQ5)**, Quantitative and qualitative findings were synthesized through a convergent mixed-methods approach (Creswell & Creswell, 2018). Convergences (e.g., high adherence but weak achievement links) and divergences (e.g., teacher adaptations enhancing learning) were identified to develop the AFF. A theoretical integration process mapped findings onto fidelity, adaptation, and contextual moderators, grounding the framework in empirical data and global implementation science (Jolles et al., 2024).

Ethical Procedures

Ethical considerations were prioritized to protect participants and ensure research integrity. Formal permission was obtained from Rosevale School's administration, and informed consent was secured from all participants, with parental consent for minors. Participants were informed of the study's objectives, voluntary nature, and right to withdraw without penalty. Confidentiality was maintained through anonymized survey codes, pseudonymized interview transcripts, and secure data storage on password-protected servers. Qualitative quotes were de-identified to prevent traceability. The study adhered to international ethical standards for educational research, including respect, beneficence, and justice (Bremner et al., 2022).

Limitations and Mitigation

The single-school context and small sample (52 students, nine teachers) limit generalizability, though purposive sampling ensured rich, context-specific insights transferable to similar LMIC settings (Hennessy et al., 2022). Self-reported survey data risked social desirability bias, mitigated by anonymous responses and triangulation with qualitative interviews and test scores. The researchers' familiarity with the school was disclosed, with reflexivity maintained through audit trails and peer debriefing to minimize bias.

Results

This section presents the findings from a mixed-methods study examining the implementation of the Dynamic Learning Program (DLP) at Rosevale School, a private secondary institution in Cagayan de Oro City, Philippines. The study integrates quantitative adherence surveys, standardized achievement tests, and qualitative interviews to address five research

questions, exploring adherence, achievement, fidelity-outcome relationships, and stakeholder experiences. The synthesis of these findings informs the development of the Adaptive Fidelity Framework (AFF), a novel model for scaling pedagogical innovations. Results are organized by research question.

Research Question 1: What is the level of adherence to the Dynamic Learning Program's components among teachers and students?

Descriptive analysis of adherence surveys (N = 52 students, N = 9 teachers) revealed moderate to high adherence to DLP's core components: independent learning activities, peer collaboration, reduced lecture time, concept integration, and discipline/routine. Responses were measured on a 5-point Likert scale (1 = Not Adherent, 5 = Highly Adherent). Teachers reported slightly higher adherence than students across all components. Table 1 summarizes the mean scores and standard deviations.

Table 1. *Adherence to the Dynamic Learning Program by Component (N = 52 students; N = 9 teachers)*

Component	Student M (SD)	Teacher M (SD)	Interpretation
Independent Learning Activities	4.10 (0.42)	4.25 (0.38)	Adherent
Peer Collaboration	3.95 (0.51)	4.15 (0.44)	Adherent
Reduced Lecture Time	4.05 (0.46)	4.30 (0.40)	Adherent
Integration of Concepts	3.90 (0.49)	4.05 (0.52)	Adherent
Discipline and Routine	4.20 (0.40)	4.35 (0.37)	Adherent
Overall Adherence	4.04 (0.48)	4.22 (0.43)	Adherent

Table 1 presents the adherence levels to the Dynamic Learning Program as perceived by both students (N = 52) and teachers (N = 9) across several key components. Overall, both groups reported high adherence, with mean scores ranging from 3.90 to 4.35, all falling within the "Adherent" category. Students rated Discipline and Routine the highest (M = 4.20, SD = 0.40), indicating strong consistency in maintaining structured learning habits, while Integration of Concepts received the lowest mean (M = 3.90, SD = 0.49), suggesting this area may require further reinforcement. Teachers, on the other hand, consistently provided slightly higher ratings than students, with their highest score also in Discipline and Routine (M = 4.35, SD = 0.37) and the lowest in Integration of Concepts (M = 4.05, SD = 0.52). The overall adherence scores—4.04 (SD = 0.48) for students and 4.22 (SD = 0.43) for teachers—indicate that the program was successfully implemented and well-accepted, though some components may benefit from additional support to ensure balanced integration.

Research Question 2: What are the achievement outcomes of students in English, Mathematics, and Physics?

Standardized diagnostic tests from the Center for Educational Measurement (CEM) assessed student achievement (N = 52) in English, Mathematics, and Physics. Scores were reported as percentile ranks and stanines, with performance categorized relative to national norms. Table 2 summarizes the results.

Table 2. *Student Achievement Scores in Standardized Tests (N = 52)*

Subject	Mean Percentile	Stanine	Interpretation
English	65	6	High Average
Mathematics	42	4	Below Average
Physics	35	3	Low Average

Table 2 displays the student achievement scores in standardized tests across three core subjects for 52 students. The results reveal varying levels of performance, with the strongest

outcome observed in English, where students achieved a mean percentile of 65 and a stanine score of 6, which falls within the *High Average* category. In contrast, performance in Mathematics was notably weaker, with a mean percentile of 42 and a stanine score of 4, categorized as *Below Average*. The lowest achievement was recorded in Physics, with a mean percentile of 35 and a stanine score of 3, placing students in the *Low Average* range. These findings indicate that while students demonstrate relative strength in language proficiency, their performance in mathematics and science subjects requires targeted intervention to bridge learning gaps and improve academic outcomes in these critical areas.

Research Question 3: What is the relationship between adherence to the DLP and student achievement in English, Mathematics, and Physics?

Multiple regression analyses examined the relationship between adherence to DLP components (independent learning activities, peer collaboration, reduced lecture time, concept integration, discipline/routine) and achievement (percentile ranks) in English, Mathematics, and Physics (N = 52). Hierarchical regression tested moderation by teacher experience (categorized as low [0–3 years], medium [4–7 years], high [8+ years]) and student readiness (self-reported prior knowledge, derived from survey items). Assumptions of normality, linearity, homoscedasticity, and multicollinearity (VIF < 3.5) were met, verified via Shapiro-Wilk tests and scatterplots. Analyses were conducted using SPSS version 26. Table 3 presents results for the final model (Step 3, including interactions).

Table 3. Multiple Regression Results for DLP Adherence and Achievement (N = 52)

Subject	Predictor	B (SE)	β	p	Adjusted R²	Cohen's f²
English					.15	.18
	Independent Learning	.09 (.04)	.17	**.032**		
	Peer Collaboration	.11 (.05)	.20	**.026**		
	Reduced Lecture Time	.04 (.04)	.07	.310		
	Concept Integration	.05 (.05)	.09	.280		
	Discipline/Routine	.08 (.04)	.15	.060		
	Teacher Experience × Ind. Learning	.04 (.02)	.12	.090		
Math					.09	.10
	Independent Learning	.03 (.05)	.05	.480		
	Peer Collaboration	.07 (.05)	.12	.170		
	Reduced Lecture Time	-.03 (.04)	-.06	.470		
	Concept Integration	.02 (.05)	.04	.620		
	Discipline/Routine	.04 (.04)	.07	.340		
	Student Readiness × Ind. Learning	.03 (.02)	.09	.220		
Physics					.11	.12
	Independent Learning	.02 (.05)	.04	.590		
	Peer Collaboration	.08 (.05)	.14	.130		
	Reduced Lecture Time	-.04 (.04)	-.08	.390		
	Concept Integration	.03 (.05)	.06	.510		
	Discipline/Routine	.05 (.04)	.09	.250		
	Student Readiness × Ind. Learning	.05 (.02)	.15	.070		

For English, independent learning (β = .17, p = .032) and peer collaboration (β = .20, p = .026) were significant predictors, with the model explaining 15% of variance (adjusted R² = .15, f² = .18). No significant moderation effects were found. For Mathematics and Physics, no components or interactions were significant, with models explaining minimal variance (adjusted R² = .09 and .11, respectively).

Research Question 4: How do teachers and students describe their experiences of implementing and engaging with the DLP in their school context?

Thematic analysis of semi-structured interviews (10 students, 5 teachers) followed Braun and Clarke's (2006) six-phase framework: familiarization, coding, theme generation, review, definition, and reporting. Two researchers coded transcripts independently, achieving 85% inter-coder agreement, with discrepancies resolved through discussion. Three overarching themes emerged, each with subthemes, presented in Table 4 with illustrative quotes.

Table 4. *Themes, Subthemes, and Illustrative Quotes from Teacher and Student Interviews*

Theme	Subtheme	Illustrative Quote	Interpretation
Independence and Self-Regulation	Discipline and responsibility	"I learned to solve problems on my own before asking for help." (Student 3)	DLP fostered autonomy, aligning with self-regulated learning principles.
	Teacher perspectives	"My students became more responsible for their work." (Teacher A)	Teachers observed increased student ownership, supporting DLP's design goals.
Struggles with Concept Mastery	Need for guided explanation	"Physics formulas are hard to understand just from activities." (Student 7)	Reduced lecturing limited scaffolding, hindering STEM comprehension.
	Teacher concerns	"Students submit activities but struggle to explain concepts." (Teacher D)	Superficial task completion highlighted gaps in deep understanding.
Adaptation and Contextual Challenges	Teacher adjustments	"I add short Math explanations because students need guidance." (Teacher F)	Teachers adapted DLP to ensure comprehension, balancing fidelity and flexibility.
	Student reception	"Teacher explanations make me feel less lost." (Student 9)	Students valued adaptations, enhancing DLP's accessibility.

Table 4 highlights the key themes, subthemes, and illustrative quotes that emerged from teacher and student interviews regarding the implementation of the Dynamic Learning Program (DLP). The first theme, Independence and Self-Regulation, underscores how the program nurtured student autonomy and responsibility. Students reported learning to solve problems independently, while teachers observed an increase in student accountability—both reflecting DLP's emphasis on self-regulated learning. The second theme, Struggles with Concept Mastery, points to challenges in understanding complex subjects, particularly in STEM areas. Students expressed difficulty grasping concepts, such as physics formulas, when instruction was limited to activities, and teachers echoed this concern by noting that task completion did not always translate to deeper comprehension. The third theme, Adaptation and Contextual Challenges, captures the balance between adhering to DLP principles and addressing learner needs. Teachers reported making adjustments, such as adding brief explanations, to support understanding, while students appreciated these modifications, stating that additional guidance reduced confusion. Collectively, the findings suggest that while DLP fosters independence, its successful implementation requires flexible adaptation, particularly in subjects demanding conceptual scaffolding.

Research Question 5: Based on quantitative and qualitative findings, what conceptual framework best captures the dynamics of fidelity, adaptation, and context in the DLP?

Quantitative findings revealed high adherence (M = 4.04–4.22) but weak achievement correlations (adjusted R^2 = .09–.15), indicating fidelity alone does not drive outcomes. Qualitative data illuminated this paradox: DLP fostered independence, but STEM challenges prompted teacher adaptations (e.g., supplemental explanations), which students valued. Integration of

these strands highlighted that strict fidelity without adaptation leads to shallow learning, while flexibility enhances relevance. These insights provided the empirical foundation for the AFF. **The Adaptive Fidelity Framework (AFF)**, The AFF reconceptualizes implementation fidelity as a dynamic interplay of three dimensions: 1) Fidelity: Adherence to core pedagogical principles (e.g., DLP's student-centeredness, reduced lecturing). 2) Adaptation: Teacher-led modifications to meet learner needs and contextual realities (e.g., adding STEM explanations). 3) Contextual Moderators: Factors like teacher expertise, student readiness, resources, and curriculum demands shaping implementation. *Proposition:* Educational outcomes are maximized when fidelity, adaptation, and contextual moderators interact dynamically. High fidelity without adaptation risks rigidity and superficial learning; excessive adaptation without fidelity dilutes the model. Optimal effectiveness emerges when teachers uphold core principles while adapting to local contexts.
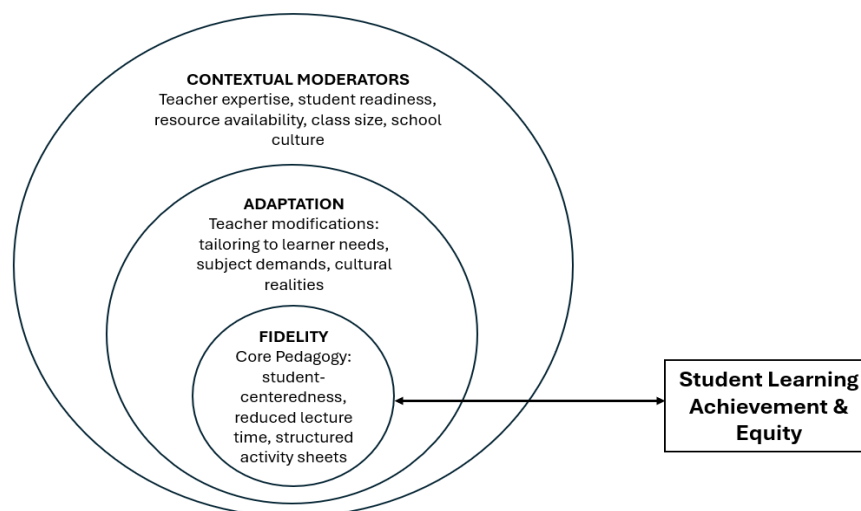

Figure 1. *The Adaptive Fidelity Framework (AFF). The AFF is visually represented as a concentric model to illustrate the dynamic interplay of three dimensions influencing student outcomes in the Dynamic Learning Program (DLP).*

The innermost ring, Fidelity, represents strict adherence to DLP's core pedagogical principles, such as student-centered learning through independent activities and minimal lecturing, ensuring the program's integrity (Lynch et al., 2019). This core reflects the study's finding of high adherence among teachers and students, crucial for preserving DLP's constructivist foundation (Xie et al., 2019). The middle ring, Adaptation, depicts teacher-led modifications, such as supplemental STEM explanations to address conceptual challenges, highlighting teacher agency in tailoring practices to classroom realities (Driessen-Willems et al., 2025). This ring connects to qualitative findings showing teachers' adaptations mitigated STEM struggles, aligning with global evidence on the need for flexibility in student-centered pedagogies (Haßler et al, 2021). The outer ring, Contextual Moderators, encompasses factors like teacher expertise, student readiness, and resource availability, which shape implementation outcomes (Jolles et al., 2024). Bidirectional arrows link all three dimensions to each other and to Student Outcomes at the model's core, illustrating their reciprocal interactions. These findings, grounded in mixed-methods convergence, underscore the AFF's proposition: optimal outcomes arise when fidelity and adaptation balance within contextual constraints, distinguishing it from linear fidelity models (Lynch et al., 2019).

The concentric design of the AFF figure visually captures the study's empirical findings, where high fidelity alone yielded modest English achievement but weak STEM outcomes, necessitating teacher adaptations to address contextual barriers like limited scaffolding (Bremner et al., 2022). This visual model extends prior frameworks by integrating adaptation as a co-equal dimension, as seen in European study, where adaptive fidelity improved STEM engagement, and U.K. research, which emphasized teacher agency in reform success (Tolmatcheff et al, 2024 ; Sims & Fletcher-Wood's, 2021). By placing Student Outcomes at the core, connected by bidirectional arrows, the figure illustrates how the AFF's dynamic approach applies to diverse settings, from resource-constrained LMICs to well-resourced high-income contexts, offering a practical tool for teacher education and policy to scale equitable reforms (Sharathbabu, 2025).

Discussion

This study's findings on the Dynamic Learning Program (DLP) implementation at Rosevale School in the Philippines provide critical insights into the dynamics of student-centered pedagogies in low- and middle-income countries (LMICs), contributing to global educational research and teacher education. By integrating quantitative and qualitative data through a mixed-methods design, the study revealed high adherence to DLP's components, variable achievement outcomes, modest fidelity-achievement links, and the pivotal role of teacher adaptations, culminating in the development of the Adaptive Fidelity Framework (AFF). These findings are confirmed and contrasted with prior studies to strengthen their global relevance, offering a nuanced understanding of implementation science and practical implications for scaling equitable reforms.

The high adherence to DLP's components—independent learning, peer collaboration, reduced lecturing, concept integration, and discipline—indicates successful institutionalization, aligning with DLP's student-centered design rooted in constructivism and self-regulated learning (Xie et al., 2019). Teachers' higher adherence scores, likely due to professional development, contrast with students' slightly lower ratings, suggesting variability in engagement with peer collaboration and concept integration. This aligns with who found high teacher fidelity to inquiry-based learning in U.S. schools due to robust training (Andrews et al, 2019). But contrasts with where limited training in Sub-Saharan African schools reduced student engagement with student-centered tasks (Haßler et al, 2021). Similarly, confirmed that high adherence in LMIC pedagogies often occurs but does not guarantee outcomes without adaptation, mirroring this study's findings (Snilstveit et al, 2016). Globally, high fidelity is seen as essential for program effectiveness (Lynch et al., 2019). But these comparisons underscore a gap in LMICs, where adherence alone is insufficient without contextual flexibility, as seen in Finland's inquiry-based learning, which balances fidelity with teacher agency (Kang & Keinonen, 2018).

Achievement outcomes showed strong performance in English but weaker results in Mathematics and Physics, reflecting global trends where literacy often outpaces STEM in LMICs (OECD, 2023a; Snilstveit et al., 2016). English proficiency benefits from its role as the medium of instruction, while STEM subjects require conceptual scaffolding that DLP's reduced lecturing may not fully provide (Idris et al., 2024). This mirrors findings in Finland, where inquiry-based learning enhanced engagement but required scaffolding for STEM mastery, and observation of STEM struggles in African student-centered programs due to resource constraints (Kang and Keinonen's, 2018 ; Haßler et al, 2021). In contrast, found modest STEM gains in U.S. personalized learning with high teacher support, highlighting the role of context (Baird & Pane, 2019). These disparities confirm that DLP's high fidelity does not uniformly translate to

achievement, particularly in STEM, aligning with global evidence that pedagogical effectiveness depends on subject-specific and contextual factors (The Brookings Institution, 2019).

The modest predictive power of adherence on English achievement, but not Mathematics or Physics, as shown through multiple regression, underscores that fidelity alone does not drive outcomes, especially in complex subjects. This is confirmed by who reported stronger literacy gains in inquiry-based learning, who found weak STEM correlations in LMIC programs due to contextual barriers (Kang & Keinonen, 2018). Conversely, U.S. study showed modest STEM gains only with significant scaffolding, unlike DLP's minimal lecturing approach (Baird and Pane's, 2019). The non-significant moderation effects of teacher experience and student readiness suggest indirect influences, possibly through adaptations, supporting the AFF's focus on contextual moderators (Jolles et al., 2024). These findings challenge compliance-based fidelity models aligning with, who advocate adaptive approaches in European STEM programs for diverse contexts (Lynch et al., 2019; Tolmatcheff et al, 2024).

Qualitative insights revealed DLP's success in fostering independence and self-regulation, consistent with constructivist and self-regulated learning theories (Bhardwaj et al., 2025; Xie et al., 2019). but highlighted STEM concept mastery challenges due to reduced lecturing. Teachers' adaptations, such as brief lectures or group work, were positively received, reflecting adaptive fidelity (Driessen-Willems et al., 2025). This aligns with who found U.S. inquiry-based learning enhanced autonomy, but contrasts with, where LMIC students struggled with autonomy due to limited prior exposure (Andrews et al, 2019; Idris et al, 2024). confirmed that teacher adaptations in U.S. science curricula improved engagement, unlike rigid implementations, while noted similar STEM scaffolding needs in African programs (Penuel et al. (2017 ; Haßler et al, 2021). These comparisons explain the weak fidelity-achievement links, as adaptations mitigated strict adherence limitations, particularly in STEM, resonating with LMIC contexts where rigid implementation falters (Hennessy et al., 2022). The AFF, developed from these findings, redefines fidelity as a dynamic interplay of adherence, teacher-driven adaptation, and contextual moderators, offering a novel model for scaling educational innovations. Unlike compliance-focused framework, which faltered in diverse settings, the AFF aligns with) adaptive approach in European programs and African study, where teacher flexibility enhanced outcomes (Lynch et al, 2019 ; Haßler et al, 2021 ; Tolmatcheff et al, 2024). Its emphasis on contextual responsiveness addresses LMIC challenges, where reforms often fail without adaptation (Snilstveit et al., 2016). The AFF's empirical grounding through mixed-methods convergence strengthens its novelty, contrasting with linear models and confirming its applicability across diverse systems (Jolles et al., 2024).

The AFF advances implementation science by reframing fidelity to include adaptation as a co-equal dimension, elevating teacher agency as co-designers of reform (Hill, Lovison, & Kelley-Kemple, 2019; Sims & Fletcher-Wood, 2021), and ensuring contextual relevance for LMICs and beyond (Bremner et al., 2022; Sharathbabu, 2025). For teacher education, the AFF advocates training educators as adaptive implementers, a model supported by Sims and Fletcher-Wood (2021), who found adaptability improved U.K. teacher training outcomes. Professional development should foster reflective practice, applicable globally (Haßler et al., 2021). For policy, it supports monitoring systems assessing fidelity and adaptation, aligning with OECD's (2023a) flexible frameworks, unlike rigid policies that fail in LMICs (Snilstveit et al., 2016). The AFF offers a scalable, equitable approach, with the Philippine case contributing to global discourses on sustainable reform.

Conclusion

This mixed-methods study of the Dynamic Learning Program (DLP) at Rosevale School addressed five research questions, revealing high adherence to DLP's student-centered components, stronger English achievement than in Mathematics and Physics, modest fidelity-achievement links, and the critical role of teacher adaptations, such as supplemental STEM explanations. These findings informed the Adaptive Fidelity Framework (AFF), fulfilling the objective to develop a framework for scaling equitable reforms. The AFF redefines fidelity as a dynamic balance of adherence to core principles, teacher-led adaptation, and contextual factors like resources and student readiness. Unlike rigid models, it positions teachers as co-designers who tailor innovations to local contexts while preserving pedagogical integrity, offering a transformative approach for low- and middle-income countries and high-income systems seeking flexible, inclusive reforms. For teacher education, the AFF emphasizes training educators as adaptive implementers, fostering reflective practice to balance fidelity with flexibility across diverse settings. For policymakers, it advocates monitoring systems that value both adherence and adaptation, ensuring feasible and equitable reforms aligned with global equity goals. The single-school context limits broad generalizability, but the findings' transferability supports wider application. Future research should validate the AFF through multi-site, longitudinal studies in diverse educational systems, exploring additional factors like class size or digital resources and testing its applicability to other student-centered approaches, such as inquiry-based learning. By emphasizing adaptive fidelity, the AFF equips educators and policymakers to advance sustainable, equitable educational reforms globally, with this Philippine case serving as a compelling example.

Acknowledgment

References

Andrews, T. C., Conaway, E. P., Zhao, J., & Dolan, E. L. (2016). Colleagues as change agents: How department networks and opinion leaders influence teaching at a single research university. *CBE—Life Sciences Education, 15*(2), ar15. https://doi.org/10.1187/cbe.15-08-0170

Angrist, N., Bergman, P., Evans, D. K., Hares, S., Jukes, M. C. H., & Letsomo, T. (2020). Practical lessons for phone-based assessments of learning. *BMJ Global Health, 5*(7), e003030. https://doi.org/10.1136/bmjgh-2020-003030

Baird, M. D., & Pane, J. F. (2019). Translating standardized effects of education programs into more interpretable metrics. *Educational Researcher, 48*(4), 217–228. https://doi.org/10.3102/0013189X19848729

Bailey, D. H., Duncan, G. J., Murnane, R. J., & Au Yeung, N. (2021). Achievement gaps in the wake of COVID-19. *Educational Researcher, 50*(5), 266–275. https://doi.org/10.3102/0013189X211011237

Bhardwaj, V., Zhang, S., Tan, Y. Q., & Pandey, V. (2025). Redefining learning: Student-centered strategies for academic and personal growth. *Frontiers in Education, 10,* Article 1518602. https://doi.org/10.3389/feduc.2025.1518602

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Bremner, N., Sakata, N., & Cameron, L. (2022). The outcomes of learner-centred pedagogy: A systematic review. *International Journal of Educational Development, 94,* 102649. https://doi.org/10.1016/j.ijedudev.2022.102649

Brookings Institution. (2019, August 1). *Scaling education programs in the Philippines: A policymaker's perspective.* Brookings.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

de Leeuw, A., Happé, F., & Hoekstra, R. A. (2020). A conceptual framework for understanding the cultural and contextual factors on autism across the globe. *Autism Research, 13*(7), 1029–1050. https://doi.org/10.1002/aur.2276

Driessen, E. P., Knight, J. K., Smith, M. K., & Ballen, C. J. (2020). Demystifying the meaning of active learning in postsecondary biology education. *CBE—Life Sciences Education, 19*(4), ar52. https://doi.org/10.1187/cbe.20-04-0068

Driessen-Willems, M. D., Bartelink, N. H. M., Bessems, K. M. H. H., Kremers, S. K., & van Assema, P. (2025). Balancing fidelity and adaptation: Action-oriented research towards implementing a nutrition education program among adolescents. *The Journal of School Health.* Advance online publication. https://doi.org/10.1111/josh.70009

Escueta, M., Quan, V., Nickow, A. J., & Oreopoulos, P. (2017). *Education technology: An evidence-based review* (NBER Working Paper No. 23744). https://doi.org/10.3386/w23744

Flegr, S., Kuhn, J., & Scheiter, K. (2023). When the whole is greater than the sum of its parts: Combining real and virtual experiments in science education. *Computers & Education, 197,* 104745. https://doi.org/10.1016/j.compedu.2023.104745

Goss, P., Sonnemann, J., & Griffiths, K. (2017). *Engaging students: Creating classrooms that improve learning* (Grattan Institute Report No. 2017-01). Grattan Institute.

Haßler, B., Bennett, G., & Damani, K. (2021). Teacher professional development in sub-Saharan Africa. In B. Haßler, G. Bennett, & K. Damani (Eds.), *Embedding social justice in teacher education and development in Africa* (pp. 18–44). Routledge. https://doi.org/10.4324/9780429341212-3

Hill, H. C., Lovison, V., & Kelley-Kempe, T. (2019). Mathematics teacher and curriculum quality, 2005 and 2016. *AERA Open, 5*(4). https://doi.org/10.1177/2332858419880521

Huber, S. G., & Helm, C. (2020). COVID-19 and schooling: Evaluation, assessment and accountability in times of crises—Reacting quickly to explore key issues for policy, practice, and research with the school barometer. *Educational Assessment, Evaluation and Accountability, 32*(2), 237–270. https://doi.org/10.1007/s11092-020-09322-y

Idris, N. I., Ali, N. L., & Mohd Don, Z. (2024). English-medium instruction programme in Malaysia: Readability of science textbooks used in Dual Language Programme at primary schools. *Issues in Language Studies, 13*(2), 1–20. https://doi.org/10.33736/ils.6290.2024

Jolles, M. P., Fort, M. P., & Glasgow, R. E. (2024). Aligning the planning, development, and implementation of complex interventions … with an equity focus: Application of the PRISM/RE-AIM Framework. *International Journal for Equity in Health, 23,* Article 41. https://doi.org/10.1186/s12939-024-02130-6

Kang, J., & Keinonen, T. (2018). The effect of student-centered approaches on students' interest and achievement in science: Relevant topic-based, open and guided inquiry-based, and discussion-based approaches. *Frontiers in Psychology, 9,* Article 589. https://doi.org/10.1007/s11165-016-9590-2

Kizilcec, R. F., Pérez-Sanagustín, M., & Maldonado, J. J. (2017). Self-regulated learning strategies predict learner behavior and goal attainment in massive open online courses. *Computers & Education, 104,* 18–33. https://doi.org/10.1016/j.compedu.2016.10.001

Kraft, M. A., Allensworth, E., & Schwartz, N. (2021). *School practices to address student learning loss.* EdResearch for Action.

Kraft, M. A., Blazar, D., & Hogan, D. (2018). The effect of teacher coaching on instruction and achievement: A meta-analysis of the causal evidence. *Review of Educational Research, 88*(4), 547–588. https://doi.org/10.3102/0034654318759268

Lynch, K., Hill, H. C., Gonzalez, K. E., & Pollard, C. (2019). Strengthening the Research Base That Informs STEM Instructional Improvement Efforts: A Meta-Analysis. *Educational Evaluation and Policy Analysis, 41*(3), 260–293. https://doi.org/10.3102/0162373719849044

Macnamara, B. N., & Burgoyne, A. P. (2023). Do growth mindset interventions impact students' academic achievement? A systematic review and meta-analysis with recommendations for best practices. *Psychological Bulletin, 149*(3–4), 133–173. https://doi.org/10.1037/bul0000352

OECD. (2023a). *PISA 2022 results (Volume I): The state of learning and equity in education.* OECD Publishing. https://doi.org/10.1787/53f23881-en

OECD. (2023b). *PISA 2022 results (Volume II): Learning during—and from—disruption.* OECD Publishing. https://doi.org/10.1787/a97db61c-en

OECD. (2024). *PISA 2022 results (Volume III): Creative minds, creative schools.* OECD Publishing. https://doi.org/10.1787/765ee8c2-en

Penuel, W. R., Allen, A. R., Coburn, C. E., & Farrell, C. (2015). Conceptualizing research–practice partnerships as joint work at boundaries. *Journal of Education for Students Placed at Risk, 20*(1–2), 5–24. https://doi.org/10.1080/10824669.2014.988334

Quinn, D. M., & Kim, J. S. (2017). Scaffolding fidelity and adaptation in educational program implementation. *American Educational Research Journal, 54*(6), 1111–1150. https://doi.org/10.3102/0002831217717692

Reich, J., Buttimer, C. J., Fang, A., Hillaire, G., Hirsch, K., Larke, L. R., & Slama, R. (2020). Remote learning guidance from state education agencies during the COVID-19 pandemic: A first look [Preprint]. *EdArXiv.* https://doi.org/10.35542/osf.io/437e2

Sharathbabu, V. (2025). Adapting international best practices for local education reform: Opportunities and challenges. *International Journal of Social Impact, 10*(1), 63–69. https://doi.org/10.25215/2455/1001S10

Sims, S., & Fletcher-Wood, H. (2021). Identifying the characteristics of effective teacher professional development: A systematic review and meta-analysis. *School Effectiveness and School Improvement, 32*(2), 303–324. https://doi.org/10.1080/09243453.2020.1772841

Sisk, V. F., Burgoyne, A. P., Sun, J., Butler, J. L., & Macnamara, B. N. (2018). To what extent and under which circumstances are growth mind-sets important to academic achievement? Two meta-analyses. *Psychological Science, 29*(4), 549–571. https://doi.org/10.1177/0956797617739704

Snilstveit, B., Stevenson, J., Menon, R., Phillips, D., Gallagher, E., Geleen, M., Jobse, H., Schmidt, T., Naude, T., Parga, V., Eyers, J., Kendall, S., & Procter, I. (2016). The impact of education programmes on learning and school participation in low- and middle-income countries: A systematic review summary report (3ie Systematic Review Summary 7). International Initiative for Impact Evaluation.

Stains, M., Harshman, J., Barker, M. K., Chasteen, S. V., Cole, R., DeChenne-Peters, S. E., Eagan, K., Jr., Goldman, S. R., Holmes, C. E., Husen, N., Laird, T. F., Laski, I., Lo, S. M., McKay, T. A., Miller, S., Rutherford, A. W., Smith, N., Stetzer, M., Vinson, B. K., … Young, A. M. (2018). Anatomy of STEM teaching in North American universities. *Science, 359*(6383), 1468–1470. https://doi.org/10.1126/science.aap8892

Tlili, A., Shehata, B., Adarkwah, M. A., Bozkurt, A., Hickey, D. T., Huang, R., & Agyemang, B. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. *Smart Learning Environments, 10*(15). https://doi.org/10.1186/s40561-023-00237-x

Tolmatcheff, C., Veenstra, R., Roskam, I., van der Ploeg, M., Hofman, A., & Stevens, G. W. J. M. (2024). Examining the link between implementation fidelity, quality, and effectiveness of teacher-delivered anti-bullying interventions in a randomized controlled trial. *Prevention Science, 25*(3), 407–420. https://doi.org/10.1007/s11121-023-01580-8

Xie, K., Hensley, L. C., Law, V., & Sun, Z. (2019). Self-regulation as a function of perceived leadership and cohesion in small group online collaborative learning. *British Journal of Educational Technology, 50*(6), 2893–2911. https://doi.org/10.1111/bjet.12594