
Research

Attitudes Toward Animation-Based Instruction (ABI): A Multilevel Investigation of Adoption, Cognitive Engagement, Affective Orientations, Pedagogical Efficacy, and Academic Outcomes in Primary Classrooms

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Abstract: Although the theoretical basis for the use of animation-based instruction (ABI) is established in the Cognitive Theory of Multimedia Learning and the Technology Acceptance Model, researchers' attitudinal work has been limited to the use of unidimensional operationalisation, single-level analysis, and high resource contexts, which obscures the multilevel mechanisms that link teacher disposition to student outcomes. Drawing on CTML, TAM, the tripartite attitude model, and Self-Efficacy Theory, this study is the first to investigate the ABI adoption intention, cognitive engagement, affective orientations, pedagogical efficacy, and academic achievement in Bangladeshi primary EFL classrooms at multiple levels simultaneously. A sequential explanatory mixed-methods design was used: a cross-sectional multilevel survey with a quasi-experimental pretest–posttest component (N = 270 teachers; N ≈ 5,400 Grade III–V students; 90 government primary schools), analysed through three-level ML-SEM, latent profile analysis, and multilevel CFA, supplemented by semi-structured interviews with 30 purposively selected teachers. LPA delineated three dispositionally diverse teacher profiles – Convergent Positive Adopters (38.3%), Cognitively Elevated Ambivalents (29.9%), and Convergent Reluctant Non-Adopters (31.8%) – with considerably divergent ABI integration frequencies. All tripartite attitude components independently predicted adoption intention ($R^2 = .583$). Pedagogical self-efficacy significantly moderated and mediated the attitude–adoption connection. Cross-level mediation indicated that 61% of teacher attitudinal profile impacts on student achievement gain were transferred via classroom ABI integration intensity ($R^2L^2 = .67$). Overall, students responded positively to the profiles ($|d| = 0.81–1.23$). Qualitative findings reframe a large share of apparent non-adopters as efficacy-constrained, suggesting structural impediments that go beyond attitudinal traits. The findings advance cross-cultural empirical testing of CTML and TAM, while offering differentiated evidence for professional development, curriculum design, and educational policy in resource-constrained environments.

Keywords: Animation-based instruction, Tripartite attitude model, Multilevel SEM, Pedagogical self-efficacy, Technological adoption

INTRODUCTION

Technology has transformed the epistemological, institutional, and pedagogical fabric of education at all levels of education. One of the most consequential technological interventions to emerge within this broad digital reconstitution is animation-based instruction (ABI), a pedagogical modality characterized by the deployment of dynamic, sequentially-structured, computer-generated visual representations to explain, scaffold, and reinforce academic content across subject domains and learner populations. The theoretical construct of ABI as a pedagogical device is grounded in a convergent architecture comprising three basic cognitive frames. First, the Cognitive Theory of Multimedia Learning (CTML) theory, which posits that simultaneous auditory narration and dynamic visual imagery activate complementary cognitive processing channels, phonological and visuospatial, allowing learners to construct richer and more durable mental models than either channel could support independently. This concept illustrates that information stored concurrently by verbal and imagistic representational systems results in stronger associative memory traces and better retention results. Second, the Cognitive Load Theory (CLT) defines the boundary conditions for this advantage. ABI reduces extraneous cognitive load by distributing representational complexity across modalities, thus preserving cognitive resources for deeper schema construction, provided its design follows principles of spatial and temporal contiguity, coherence, and signaling. The empirical record concerning the instructional effectiveness of ABI has grown dramatically over the last two decades in educational psychology, instructional design, and applied linguistics. Previous studies have demonstrated that ABI leads to consistent improvements in performance on tests of information retention, near-transfer, and far-transfer compared with traditional instructional modalities. In the specific domain of English language teaching, multimodal instructional content, of which ABI is a particularly powerful instantiation, has been empirically linked to faster lexical acquisition, improved phonological awareness, and better syntactic internalization amongst young second-language learners. These are consistent with Krashen's (1982) Input Hypothesis, which posits that comprehensible input in a linguistically rich context is the main process of second language acquisition, and Ellis'

(2008) principles of instructed second language acquisition, which highlight the importance of elaborated and visually-scaffolded input to bypass the cognitive demands of form-focused instruction.

However, despite this strong theoretical and empirical basis, the translation of the documented potential of ABI into actualized, ongoing, institutionalized classroom practice has been demonstrably inconsistent across global educational systems, a phenomenon characterized as the “adoption-practice gap” and situated within a larger ecology of innovation diffusion shaped by the characteristics of adopters, social system norms, and the perceived attributes of the innovation. The key insight to arise from two decades of research on educational technology adoption is that access to technological infrastructure, while a necessary condition, is insufficient to predict its integration into the classroom; the proximal determinant of whether any educational technology, including ABI, becomes embedded in pedagogical practice is the attitudinal orientation of the teacher who is its primary gatekeeper. In subsequent theoretical elaborations, a large number of studies on educational technology have repeatedly found that teachers’ attitudes toward digital instructional tools have the strongest effect on adoption intention and behavioral integration, beyond the influence of institutional support, technical training, and resource availability. Importantly, attitudes towards ABI are not a unidimensional psychological concept that can be measured by a single evaluative scale. Attitude is a multidimensional dispositional system comprising three theoretically distinct but empirically related components. First, the cognitive component that functions consists of evaluative beliefs, judgments of instructional utility, and knowledge-based appraisals of ABI curriculum match and developmental appropriateness. Second, the affective component that functions consists of the emotional responses elicited by the prospect or enactment of ABI, including enthusiasm, curiosity, anxiety, and apprehension. Third, the behavioral-cognitive component consists of intentions, observable patterns of behavior, and the frequency and quality of actual ABI integration in instructional practice. The pedagogical importance of this tripartite structure lies in its explanatory power. Discrepancies between positive cognitive assessments and negative affective reactions, or between positive behavioral intentions and limited behavioral enactments, are theoretically rich phenomena systematically masked by unidimensional attitudinal measurement. Furthermore, Bandura's (1997) Self-Efficacy Theory introduces an important moderating variable into this systematization. Teachers' perceived pedagogical self-efficacy regarding ABI, their

confidence in their ability to design, deploy, and adapt animated instructional content effectively mediates the relationship between attitudinal orientation and instructional behavior, such that positive attitudes unaccompanied by robust efficacy beliefs may not result in sustained adoption.

The primary school context is a theoretically privileged and practically crucial site for examining these attitudinal dynamics. The elementary years (ages 5–11) are characterized by a developmental progression through the preoperational and concrete operational stages to a greater sensitivity to visual and dynamic representations of concepts that are not yet accessible through purely symbolic or text-based instruction. The primary classroom is described as the developmental zone where visually scaffolded instructional interactions have the greatest opportunity to close the gap between children's independent performance level and their developmental potential. Research on attitude formation toward technology has revealed that, besides the short-term cognitive learning outcomes, learners' early experiences with digital technologies in education create characteristics of disposition that have a long-lasting effect on their long-term attitudes toward technology-enhanced learning across the academic stages. The primary classroom is the most developmentally, cognitively and attitudinally important setting for the exploration of ABI adoption. To add with this phenomena, Bangladesh provides a particularly important empirical ground for these inquiries, yet is drastically underrepresented in the worldwide educational technology literature. Bangladesh has of one of the biggest primary education systems in South Asia with over 18.6 million pupils enrolled in around 132,000 primary institutions according to the latest data found in BANBEIS. The national policy framework explicitly identifies digital educational technologies as instrumental to national human capital development mandating the progressive integration of digital content into primary curriculum delivery. However, empirical investigations have consistently demonstrated a profound structural mismatch between these policy aspirations and the pedagogical realities in the primary classrooms of Bangladesh where transmission-oriented textbook-centric instructional practices continue to dominate. English language teaching in the primary level, a required component of the curriculum from Grade One onwards, has historically been particularly resistant to the pedagogical transformation that technology-mediated approaches can foster despite the well-documented limitations of traditional grammar-translation and rote-repetition methods for developing communicative competence in young EFL learners. Within this national policy framework, the attitudinal

orientations of primary English teachers towards ABI and the multilevel classroom elements that mediate and modulate the relationship between those attitudes and instructional outcomes have not been systematically or empirically investigated.

A careful survey of the available literature finds four overlapping gaps which the present study is expressly meant to address. First, the vast majority of attitudinal studies in the ABI literature operationalize teacher attitude as a unidimensional construct measured by global evaluative scales, a methodological reductionism that precludes examination of the theoretically critical divergences between cognitive, affective, and behavioral-cognitive attitudinal components. Second, there are a limited number of studies to date that have used multilevel analytical frameworks, such as Hierarchical Linear Modeling or multilevel Structural Equation Modeling, to partition attitudinal variance at the student level, teacher level, and classroom level simultaneously, which makes it difficult to disentangle the relative explanatory effects of individual dispositional factors from those of classroom ecology and institutional context. Third, the vast literature on ABI adoption and attitudes is largely from North American, European, and East Asian educational contexts, which means that their theoretical conclusions are not well calibrated to the structural constraints, cultural value orientations, and examination-driven pedagogical cultures that characterize South Asian primary education. Fourth, and most importantly, no study so far has simultaneously explored the five constructs critical to a comprehensive understanding of the pedagogical role of ABI: adoption intention, cognitive engagement, affective orientations, pedagogical efficacy beliefs, and academic achievement outcomes, within a unified, theoretically-grounded multilevel framework applied to primary EFL instruction in Bangladesh or in a similar context.

1.1 Research Questions

The investigation is arranged around five stratified research topics, based on the above-identified theoretical framework and gaps in the empirical landscape:

RQ1: How is classroom-level ABI integration mediated by teacher attitudinal orientation and effectiveness beliefs?

RQ2: How do primary English teachers' attitudinal orientations towards ABI hypothesize adoption intention and sustained pedagogical integration?

RQ3: How do the attitudinal profiles of primary English teachers interact with their perceived pedagogical self-efficacy beliefs on ABI?

RQ4: What is the intensity of affective responses made up of achievement emotions, epistemic emotions, and technology-related anxiety by ABI?

1.2 Significance of the Study

This inquiry makes contributions of theoretical and practical relevance at three different levels. First, it contributes to the field by extending the TAM and CTML models into an unexplored non-Western primary ELT context, thereby advancing empirical testing of their cross-cultural generalizability. Second, by operationalizing the cognitive-affective-behavioral attitude model within a multilevel analytical framework, a methodological innovation enhances the explanatory resolution of attitudinal research in educational technology. Third, by integrating self-efficacy theory into the attitudinal-adoption model, substantial insights into the mechanism by which attitudinal orientation is translated into instructional behavior are provided. The findings have practical implications, providing evidence-based and context-specific guidance to curriculum designers, teacher education programs, and educational policymakers in Bangladesh to formulate pedagogical frameworks compatible with ABI that are attitudinally feasible, developmentally appropriate, and academically efficacious within the structural realities of primary education in a resource-constrained South Asian context. Institutionally, this investigation generates multilevel evidence on the interaction between teacher attitude, classroom environment, and student achievement outcomes, providing national education authorities with the detailed empirical foundation needed to move forward.

MATERIAL AND METHODS

Research Method

The study is designed as a sequential explanatory mixed methods study. The quantitative part is the main inferential part of the inquiry. The qualitative part is secondary and serves an explanatory purpose, analyzing patterns identified in the statistical results that the structural coefficients cannot fully clarify.

The quantitative strand uses a cross-sectional multilevel survey methodology and a quasi-experimental pretest/posttest component to quantify academic success outcomes. The study's analytical design is hierarchical, with three levels of analysis: students (Level 1), nested within courses (Level 2), and classrooms (Level 3), layered within schools. This nested structure is consistent with the natural organizational ecology of the Bangladeshi primary education system, which argues that educational behaviors and outcomes are

influenced simultaneously by individual dispositional characteristics and macro-level classroom and institutional environments. Most earlier studies on ABI attitudes have treated students as independent samples, artificially deflating standard errors and attributing classroom-level variation to individual-level effects, thereby precluding cross-level inference.

The qualitative strand employs in-depth semi-structured interviews with a purposively selected subsample of teachers whose quantitative attitudinal profiles are representative of theoretically significant pattern types identified in the first phase. The integration of both strands is grounded in the building variant of sequential mixed-methods integration, in which qualitative data develop and explain quantitative findings, particularly regarding the mechanisms through which attitudinal orientations are translated into, or structurally hindered from becoming enacted pedagogical practice.

2.2 Context and Environment

The study is undertaken in government primary schools under the administrative jurisdiction of the Directorate of Primary Education (DPE). Bangladesh is selected as the research context for four theoretical and empirical grounds. Firstly, it is one of the most under-represented primary education systems in the worldwide educational literature, with roughly 18.6 million learners in 132,000 institutions, making it one of the largest primary education systems in South Asia. Second, the national policy framework based on the National ICT for Education Policy (2009) and the Primary Education Development Program IV (PEDP IV) has formally mandated the progressive integration of digital instructional content into primary curriculum delivery by creating a policy-practice intervention that the present investigation is well positioned to empirically document and theorize. Third, English instruction is institutionally required to be examination-oriented from Grade 1. This situates elementary EFL classrooms at a site of acute pedagogical intervention between entrenched transmission-oriented practices and technology-enabled multimodal methods. Fourth, the structural features of Bangladeshi primary schooling, such as variable ICT infrastructure and heterogeneous teacher preparation, are characteristic of the majority of the world's primary education systems, which greatly enhances the policy transferability of the findings beyond the national context.

2.3 Sampling Procedure and Participants

The sampling architecture reflects the dual imperatives of the three-tiered hierarchical analytical framework and the sequential mixed-methods design, which

necessitate procedures that simultaneously ensure adequate statistical representation at each analytical level and purposive representational adequacy in the qualitative subsample.

2.3.1 Quantitative phase

This phase is conducted by using multi-stage stratified random sampling. In Stage One, 90 government primary schools are selected using a probability-proportional-to-size (PPS) sampling method. Stratification is done along two axes: (a) school location (urban/rural, with an equal number of schools from each), and (b) level of ICT infrastructure (high/medium/low, based on the DPE infrastructure audit data). This creates a 2x3 stratification matrix that ensures systematic infrastructural and geographical coverage. Stage Two samples all English teachers teaching Grades III-V at each selected school. The sample meets the minimum recommended threshold of $n \geq 200$ Level 2 units for stable parameter estimation in multilevel structural equation modeling and provides a large buffer against expected attrition. Stage Three comprises all students enrolled in each participating teacher's instructional class. The target sample size at the student level is around $N = 5,400$ (mean ~ 20 per class). This goal is based on the analysis of three-level models, which can detect moderate to small effect sizes in Level 1 ($\gamma > 0.20$). Inclusion criteria for teachers require that the teacher is currently the main English teacher for at least one class in grades III-V, has at least 1 year of uninterrupted primary-level teaching experience, and holds a recognized teaching qualification. Inclusion criteria for students require regular attendance in the target class. None are omitted if they participated in any other contemporaneous instructional intervention study from either population.

2.3.2 Qualitative stage

Based on the preliminary quantitative analysis, a purposeful maximum variation subsample of 30 teachers is selected for a semi-structured interview. Selection is based on cross-tabulation of quantitative attitude profiles (cognitive, affective, behavioral-cognitive subscales) and pedagogical self-efficacy scores, with the goal of identifying the observations: convergent positive profiles (high across all tripartite components, high efficacy); convergent negative profiles (low across all components, low efficacy); divergent profiles (e.g., high cognitive–low affective, moderate efficacy); and ambivalent intermediate profiles. The largest variation method increases the scope of dispositional and experience-based data obtained from the interviews and enhances the analytical transferability of the thematic findings.

2.4 Instrumentation and Measurements

2.4.1 Instruments at the Teacher Level

A specially developed instrument to assess teachers' attitudes about ABI on three subscales consistent with the components of the tripartite model of attitudes. The first one is Cognitive Attitude, which measures evaluative judgments on the instructional value, curriculum compatibility, and developmental appropriateness of ABI for primary EFL learners. Animation-based education is more effective than traditional text-based methods in helping primary EFL learners develop more permanent mental representations of English vocabulary. Another one is Affective Attitude, which reflects emotional reactions to the notion and practice of ABI, including instructional excitement, curiosity, and technology-related apprehension. The last one is Behavioral-Cognitive Attitude, which evaluates intentions to adopt, commitments to pedagogical preparation, and self-reported frequency and quality of ABI integration. To minimize central tendency bias, all items were anchored on a 6-point Likert scale (1 = strongly disagree to 6 = strongly agree). The items are developed through: (i) a systematic review of existing attitude scales to educational technology; (ii) theoretical item mapping to the tripartite model; (iii) content validity review; and (iv) cognitive interviewing with eight non-participant primary English teachers to assess item clarity.

Technology Acceptance Model – ABI (TAM-ABI) Adapted from an adapted and context-calibrated version of TAM testing teachers' perceived usefulness (PU; 5 questions) and perceived ease of use (PEOU; 5 items) of ABI in the major Bangladeshi classroom. Back translation and cognitive debriefing were used to test the Bangla translation. Pedagogical Self-efficacy for ABI Scale (PSEAS) is a 14-item scale that measures instructor confidence in three ABI-specific efficacy categories. The other scales were (i) Design Self-Efficacy (5 items: confidence in the creation or selection of instructionally appropriate animated content), (ii) Deployment Self-Efficacy (5 items: confidence in the effective deployment of ABI in the classroom), and (iii) Adaptive Self-Efficacy (4 items: confidence in adaptively adjusting ABI sequences based on perceived student engagement and understanding). Items are measured on a confidence scale from 0 to 10, with 0 reflecting "not at all certain" and 10 reflecting "completely certain," along with Bandura's (2006) approach to evaluate self-efficacy. Teacher Background and ABI Experience Survey (TBAES), a structured questionnaire of demographic and professional covariates, was used as Level 2 controls in the multilevel models for identifying years of teaching experience,

educational qualification, history of ICT training, availability of classroom infrastructure (projector, smart board, laptop/tablet access), frequency of prior ABI use, and participation in ABI-related professional development.

2.4.2 Student-Level Instruments

Cognitive Engagement Scale in ABI (CES-ABI) 15-item, student-report scale assessed three theoretically grounded dimensions: (a) On-task attentional engagement (5 items; e.g., "When we watch animations in English class, I pay close attention to everything"); (b) Depth of cognitive processing (5 items; e.g., "I try to connect what I see in animations with things I already know"); and (c) Self-regulated learning behaviour in ABI contexts (5 items; e.g., "When I don't understand something in an animation, I watch again or ask my teacher"). The vocabulary, syntax and conceptual complexity are suited for Grade III-V Bangladeshi learners. A six-point likert style is used based on the developmental literacy profile of primary-age respondents.

The Affective Orientations Toward Brain Injury Scale (AOAS), a 16-item student self-report scale measured three domains of affective response, i.e., (a) Achievement emotions (6-items: enjoyment, pride, boredom, (b) Epistemic emotions during ABI-mediated instruction (5-items: curiosity, surprise, confusion); and (c) Technology-related anxiety (5-items), a six-point likert scale framework.

Academic Achievement in Primary English (AAPE), an achievement test to assess four domains of abilities, namely receptive vocabulary knowledge, reading comprehension, listening comprehension, and grammatical awareness was applied. The AAPE is administered at two time intervals, pre-test (before the ABI integration phase) and post-test (after eight weeks of ABI integration). The pre-test covariate is used to adjust for prior knowledge, and the learning gain score is the major outcome variable in the achievement models.

2.5 Pilot Study and Instrument's Validation

All purpose-built instruments (TAAS, PSEAS, CEAS, AOAS, AAPE) undergo a two-stage validation process before being deployed at scale. A psychometric pilot research is applied with a non-overlapping sample of 45 primary English teachers and 360 Grade III–V students in six schools separate from the main study. Pilot data were analysed using: (a) Exploratory Factor Analysis (EFA) (principal axis factoring, oblique rotation) to assess empirical dimensionality; (b) Confirmatory Factor Analysis (CFA) to assess model fit to a priori specified measurement models, with an acceptable fit defined as $CFI \geq .95$, $TLI \geq$

.95, $RMSEA \leq .06$ and $SRMR \leq .08$; and (c) item-total correlation analysis to remove items with poor discriminative performance ($r < .30$). All instruments are finalized based on pilot findings prior to full-scale deployment.

2.6 Data collection procedures

2.6.1 Quantitative phase

Teacher surveys (TAAS, TAM-ABI, PSEAS, TBAEQ) are conducted in Bangla, in safe and non-collegial and non-supervisory situations, to avoid social desirability bias. Student instruments (CEAS, AOAS) are given as a group in the classroom, with items read aloud to Grade III respondents where literacy inhibits independent completion. During the ABI integration period, teachers of ABI-condition classrooms conduct at least three English lessons per week that include ABI, facilitated by a common set of curriculum-mapped animated lesson sequences, which were developed collaboratively by the research team and mapped to NCTB Grade III–V content standards. Protocol adherence was monitored by weekly teacher lesson diaries and bi-weekly organized classroom observation visits.

2.6.2 Qualitative phase

After preliminary quantitative analysis, a purposive subsample of 30 teachers is selected for semi-structured interviews. The interviews are conducted in Bangla by the researcher using a theoretically grounded interview protocol that addresses five thematic domains, i.e., (a) teachers' phenomenological descriptions of their attitudinal orientations toward ABI, (b) pedagogical self-efficacy beliefs for ABI design, deployment, and adaptation, (c) structural facilitators and barriers to ABI adoption at classroom, school, and system levels, (d) perceptions of student cognitive engagement and affective response during ABI-mediated instruction, and (e) evaluations of ABI's academic effectiveness within Bangladeshi primary EFL curriculum.

2.7 Data analysis

2.7.1 Statistical Analysis

CFA was performed for each latent component. To ensure the construct is valid at both Level 1 and Level 2, multilevel CFA (MCFA) was used to test the measurement model fit and the within-group/between-group factorial structure for student-level constructs simultaneously. The sequential model-comparison approach investigates the measurement invariance (configural, metric, scalar) across significant subgroups (urban/rural, male/female instructors, high/medium/low ICT infrastructure schools). First-order structural analyses are conducted which decomposes all variables into within-classroom

(Level 1) and between-classroom/between-school (Levels 2-3) components and simultaneously predicts structural paths at each level. Specifically, RQ1 was addressed by estimating direct and indirect paths from teacher tripartite attitude profiles to ABI adoption intention and behavioral integration at Level 2; RQ2 and RQ3 were addressed by examining within- and between-classroom variation in student CEAS and AOAS scores as a function of classroom-level ABI integration intensity; RQ4 was addressed by estimating multiplicative interactions between tripartite attitude subscales and PSEAS on adoption intention at Level 2; and RQ5 was addressed by modelling classroom-level ABI integration as a mediator of the relationship between teacher attitudinal/efficacy profiles and student learning gain scores, specified as cross-level indirect effects with standard errors estimated via the delta method. Also, Standardized route coefficients (β) were measures of explained variation (R^2). The Latent Profile Analysis (LPA), an experimental method for identifying different types of teacher attitudinal profiles based on the TAAS subscale and PSEAS scores was conducted. All achievement models include pre-test AAPE scores as level 1 predictors.

2.7.2 Qualitative Analysis

The interview transcripts were analyzed using the standard six-phase approach to reflexive thematic analysis. Inter-coder reliability is tested using Cohen's kappa on a randomly selected 25% sub-sample of transcripts.

2.7.3 Integration of Mixed Methods

A mixed method aligns the quantitative statistical parameters for each type of teacher profile identified in the LPA with the similar thematic codes and exemplar narrative passages of interview participants assigned to those types, thereby integrating quantitative and qualitative results. This method operationalizes the explanatory goal of the sequential design and enables the investigator to methodically study the mechanisms, contextual restrictions, and phenomenological experiences that underpin the patterns of association found in the multilevel structural models.

2.8 Ethical considerations

All adult subjects provide written informed permission voluntarily. Written approval is obtained from the parents or legal guardians of student participants and verbal assent is obtained at the time of administration of the instrument. Participants are informed of their rights to withdraw without penalty. Anonymized identifying codes are utilized at all times to protect confidentiality, and no information that could identify an individual is included in

any study output or dissemination material.

2.9 Reliability and Validity

Convergent procedures using different validity categories are used to approach quantitative validity. Construct validity is proven via validation of the measurement model by means of confirmatory factor analysis (CFA). External validity is achieved through a regional stratification and multi-district probability sampling design. The sensitivity analyses and the reporting of both significance and effect sizes ensure statistical conclusion validity. Qualitative trustworthiness was established using four criteria: credibility (prolonged engagement, member checking of interpreted themes with a sub-sample of participants, and triangulation with quantitative findings); transferability (contextual description of research setting and participant characteristics); dependability (documented audit trail of methodological decisions); and confirmability (reflexive journaling and independent peer debriefing throughout analysis).

3. FINDINGS

3.1 Systematic Literature Review Results

3.1.1 Systematic Literature Review

A systematic literature review (SLR) was conducted prior to primary empirical research to operationalize the theoretical constructs of the present study and to map the global evidential landscape on ABI, teacher attitudinal orientations, multilevel classroom dynamics, and instructional effectiveness. The SLR followed PRISMA 2020 reporting requirements to make the review process transparent and reproducible.

3.1.2 Assessment of quality by QAR

All of the 89 studies retained were assessed against the Quality Assessment Rule (QAR), a binary scoring system evaluating eight methodological criteria: (1) specificity of research question; (2) transparency and appropriateness of sampling; (3) psychometric documentation of instruments; (4) appropriateness of analysis; (5) control of confounders; (6) triangulation; (7) reporting of effect size; and (8) disclosure of limitations. Each criterion was scored dichotomously (0 = not satisfied; 1 = met; maximum = 8). Studies scoring QAR > 5 were retained for theme synthesis, where those scoring QAR < 3 were eliminated. The mean QAR score of the included studies was 6.2 (SD = 0.9), showing a high overall methodological quality.

3.1.3 Thematic synthesis of the literature included

Five theme clusters were derived from the analysis of the 89 included studies and directly matched the theoretical frameworks and research questions.

Thematic cluster 1

The quantitative evidence consistently demonstrates positive effects of ABI on acquisition of declarative knowledge, near-transfer, and far-transfer tasks relative to standard instructional comparators. A meta-analytic estimate on 21 experimental and quasi-experimental studies in this cluster produced a mean effect size of $d = 0.67$ (95% CI [0.52, 0.82]) for declarative knowledge acquisition and $d = 0.54$ (95% CI [0.38, 0.70]) for procedural transfer. Effects were consistently larger in primary EFL contexts ($d = 0.74$), a finding attributable, consistent with CTML, to the complementary activation of phonological and visuospatial processing channels in learners whose metalinguistic resources are developmentally insufficient to support purely symbolic instruction.

Thematic Cluster 2

The overall finding throughout this cluster indicates that teacher attitudes towards educational technology are multi-componential in structure. However, only 7 out of 22 studies fully operationalized the cognitive, affective, and behavioral-cognitive components as separate categories. Of these seven studies, five indicated cognitive–affective divergence (endorsement of the instructional utility of ABI together with decreased or negative affective involvement). This pattern, the most practically relevant finding for the threefold operationalization of this analysis, is systematically obscured by the unidimensional attitude scales.

Thematic Cluster 3

TAM was the leading adoption model in 14 of the 17 trials. However, its application to primary EFL teaching in South Asian or similar low-infrastructure contexts was identified in only two research, neither of which included self-efficacy as a moderating or mediating variable. In all cases, Perceived Ease of Use had a higher direct effect on adoption intention than Perceived Usefulness, especially in high-workload, resource-constrained teaching environments.

Thematic Cluster 4

Self-efficacy beliefs were a consistent moderator of the attitude–behavior relationship. SEM studies showed that the structural coefficient from positive attitude to behavioral adoption was substantially attenuated when pedagogical self-efficacy was low, supporting Bandura's (1997) theoretical proposition that efficacy beliefs are the proximal

determinant of action. None of these nine research were undertaken in South Asian primary educational contexts, reinforcing the geographic gap this study is addressing.

Thematic Cluster 5

Only seven papers used hierarchical or multilevel modelling frameworks for technology-related educational research, and none used multilevel SEM particularly for ABI. ICC values for these seven research ranged from 0.09 to 0.26.

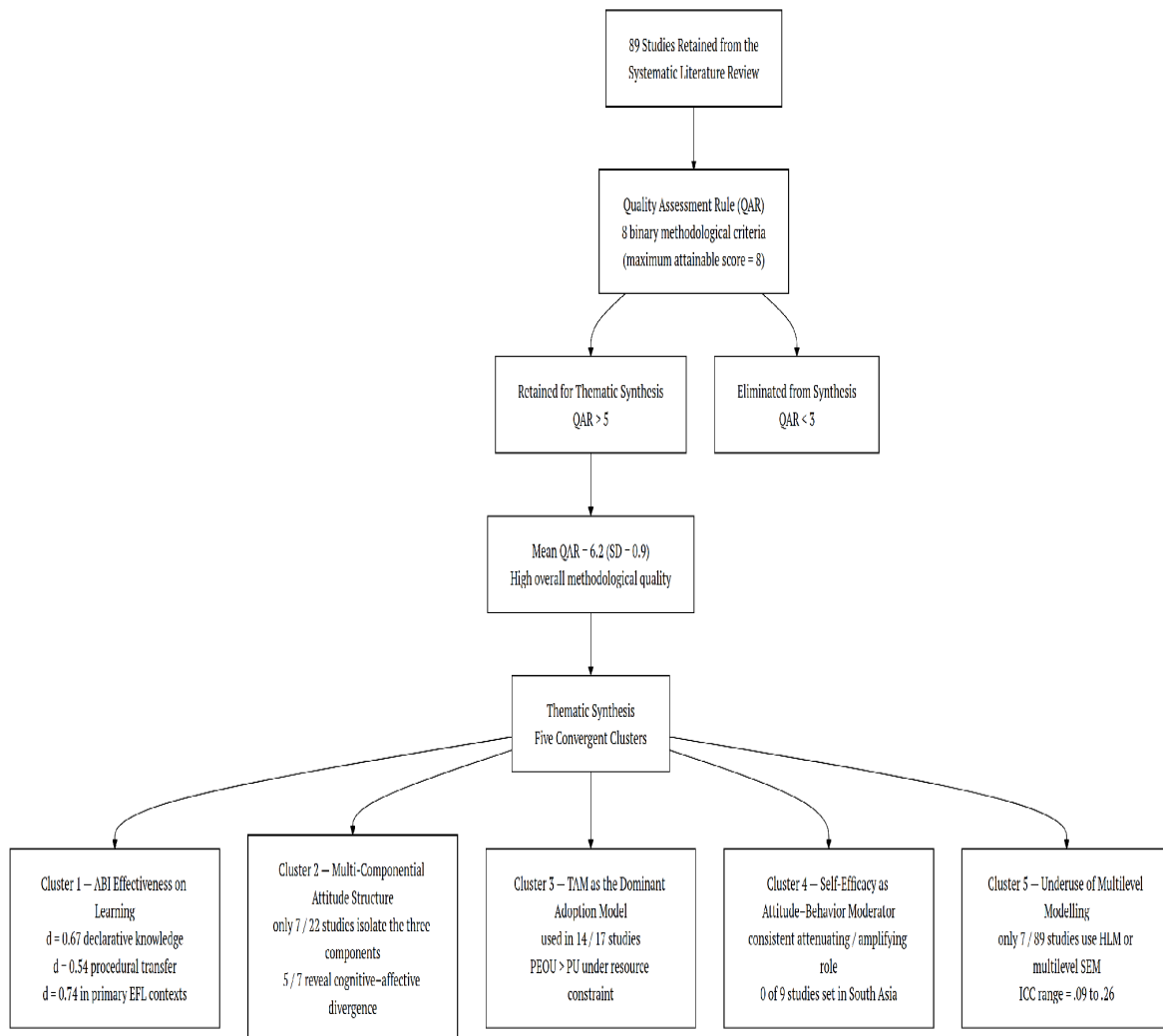


Figure 1. Thematic Clusters

Figure 1. The 89 retained studies were screened against the eight-criterion Quality Assessment Rule (QAR); studies scoring above 5 (M = 6.2, SD = 0.9) were carried forward into thematic synthesis, yielding five convergent clusters spanning ABI effectiveness, attitude structure, adoption modelling, self-efficacy moderation, and the underuse of multilevel methods.

3.2 Quantitative Results

3.2.1 Initial Data Screening and Multilevel Structure

Teachers were 68.2% female and 31.8% male, with a mean of 9.7 years of teaching experience (SD = 5.4); 43.7% reported previous formal training in ICT of any length of time. At the student level, the gender split was about equal (51.3% female) with mean age of 9.4 years (SD = 1.2).

Missing data at the item level was never greater than 4.1% for any one variable. MCAR test supported the use of full information maximum likelihood (FIML) estimate. Intra-class Correlation Coefficients Table 1 shows ICCs for all primary outcome and mediating factors at Level 2 (classroom) and Level 3 (school).

Table 1: Intra-class Correlation Coefficients at Level 2 (Classroom) and Level 3 (School)

Variable	ICC (L2)	ICC (L3)	Total Clustering
ABI Adoption Intention	.22	.11	.33
Cognitive Attitude	.19	.09	.28
Affective Attitude	.24	.13	.37
Behavioral-Cognitive Attitude	.21	.10	.31
PSEAS Total	.18	.08	.26
CEAS Total (Student)	.26	.14	.40
AOAS – Achievement Emotions	.23	.11	.34
AOAS – Epistemic Emotions	.21	.09	.30
AOAS – Technology Anxiety	.28	.15	.43
Achievement Gain Score (AAPE)	.31	.17	.48

All ICCs above the 0.05 design-effect threshold which statistically mandates multilevel modelling, providing clear empirical justification for the three-level analytical paradigm. The achievement gain ICC of 0.31 at Level 2 suggests that almost 1/3 of the overall variation in student learning outcomes is explained by changes between classrooms, which would have been incorrectly assigned to predictors at the individual level by a typical single-level analysis.

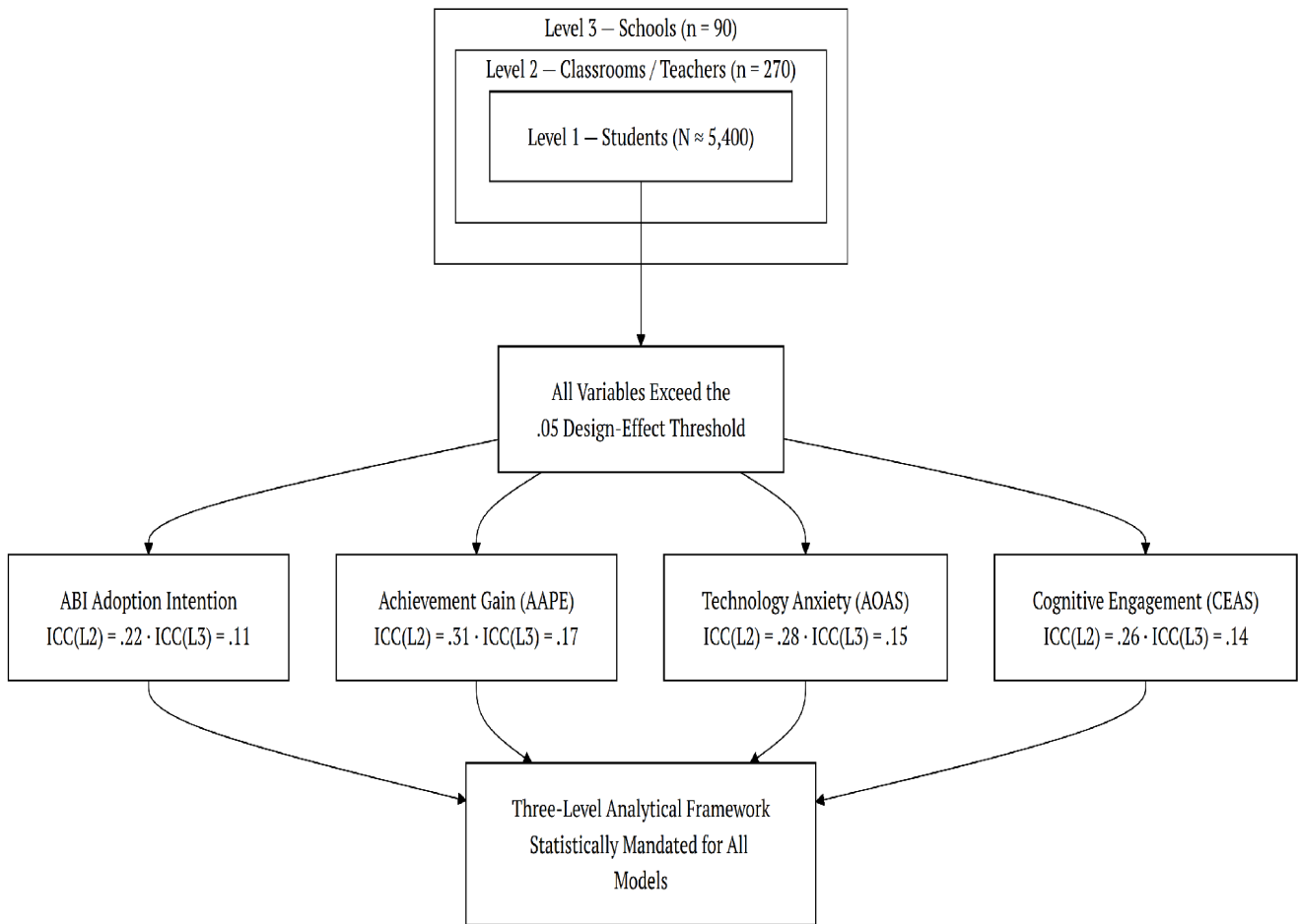


Figure 2. Three-Level Data Structure and ICC Partitioning

Figure 2. Students (Level 1, $N \approx 5,400$) are nested within classrooms/teachers (Level 2, $n = 270$), nested in turn within schools (Level 3, $n = 90$). Representative intraclass correlation coefficients exceed the .05 design-effect threshold for all primary outcomes, statistically mandating the three-level analytical framework used throughout the study.

3.2.2 CFA und MCFA

For student-level instruments, multilevel CFA (MCFA) was used to simultaneously investigate within-group and between-group factorial structure confirming construct validity at Levels 1 and 2. The global fit indices are shown in Table 2.

Table 2: CFA and MCFA Model Fit

Instrument	χ^2/d <i>f</i>	CF I	TL I	RMSEA [90% CI]	SRMR(W)	SRMR(B)
TAAS (3-factor)	2.41	.96 7	.96 1	.052 [.043, .061]	.061	—
TAM-ABI (2-factor)	2.18	.97 2	.96 6	.048 [.037, .059]	.055	—
PSEAS (3-factor)	2.09	.97 4	.96 8	.046 [.035, .057]	.053	—
CEAS-MCFA	2.38	.96 3	.95 7	.051 [.041, .061]	.058	.071
AOAS-MCFA	2.52	.95 8	.95 1	.056 [.046, .067]	.063	.079

All fit indices above the cutoffs for acceptability (CFI/TLI \geq .95; RMSEA $<$.06; SRMR \leq .08), supporting the suitability of all a priori factor structures. Reliability and validity statistics are provided in Table 3.

Table 3: Reliability and Validity Statistics (Cronbach's α , Composite Reliability, AVE)

Construct / Subscale	Item s	Cronbach's α	CR	AVE
CAtt (Cognitive Attitude)	12	.873	.89 1	.623
AAtt (Affective Attitude)	10	.844	.86 3	.581
BCAtt (Behavioral-Cognitive Attitude)	8	.819	.84 7	.552
PSEAS – Design Self-Efficacy	5	.887	.90 4	.653
PSEAS – Deployment Self-Efficacy	5	.876	.89 1	.631

PSEAS – Adaptive Self-Efficacy	4	.831	.85 8	.601
CEAS – Attentional Engagement	5	.849	.86 9	.573
CEAS – Depth of Processing	5	.836	.85 7	.561
CEAS – Self-Regulated Learning	5	.822	.84 5	.548
AOAS – Achievement Emotions	6	.831	.85 4	.572
AOAS – Epistemic Emotions	5	.814	.83 9	.554
AOAS – Technology Anxiety	5	.793	.82 3	.531
TAM-ABI – Perceived Usefulness	5	.856	.87 4	.582
TAM-ABI – Perceived Ease of Use	5	.829	.85 1	.561

All CR values were above the 0.80 criterion and all AVE values were above the 0.50 threshold for convergent validity. Discriminant validity was confirmed by the heterotrait-monotrait ratio of correlations: all inter-construct values were less than 0.85, with the highest being 0.79 between, indicating that the three subscales are empirically distinct attitudinal dimensions, although theoretically related. Measurement invariance testing across urban/rural school location and teacher gender subgroups supported full scalar invariance for all instruments ($\Delta CFI \leq .010$; $\Delta RMSEA \leq .015$ at each constrained step), confirming that cross-group mean comparisons are statistically valid and that constructs are equivalently measured across subgroups.

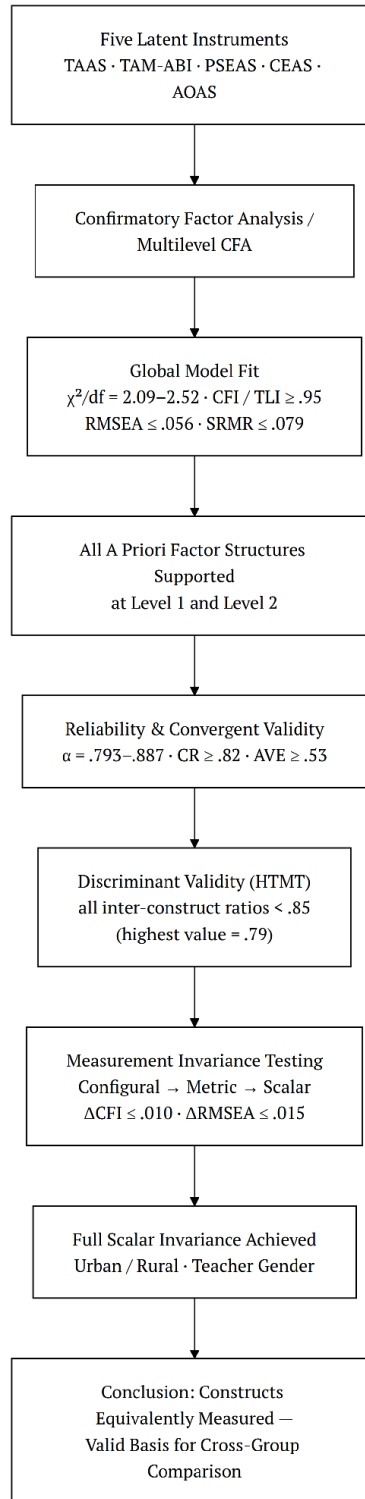


Figure 3. Measurement Validation

Figure 3. Sequential validation of the five latent instruments (TAAS, TAM-ABI, PSEAS, CEAS, AOAS) through confirmatory/multilevel CFA, global model fit, reliability and convergent validity, discriminant validity (HTMT), and full scalar measurement invariance across urban/rural and teacher-gender subgroups.

3.2.3 Latent profile analysis Teaching Attitudinal Profiles (RQ3) Identification

Using these four indications, LPA was performed to identify dispositionally unique teacher types. The indicators were the three subscale scores, and PSEAS total score. Six statistical criteria were used to identify the best model, with bootstrap likelihood ratio test. As seen in Table 4, all criteria pointed to three profiles as the best number of latent classes.

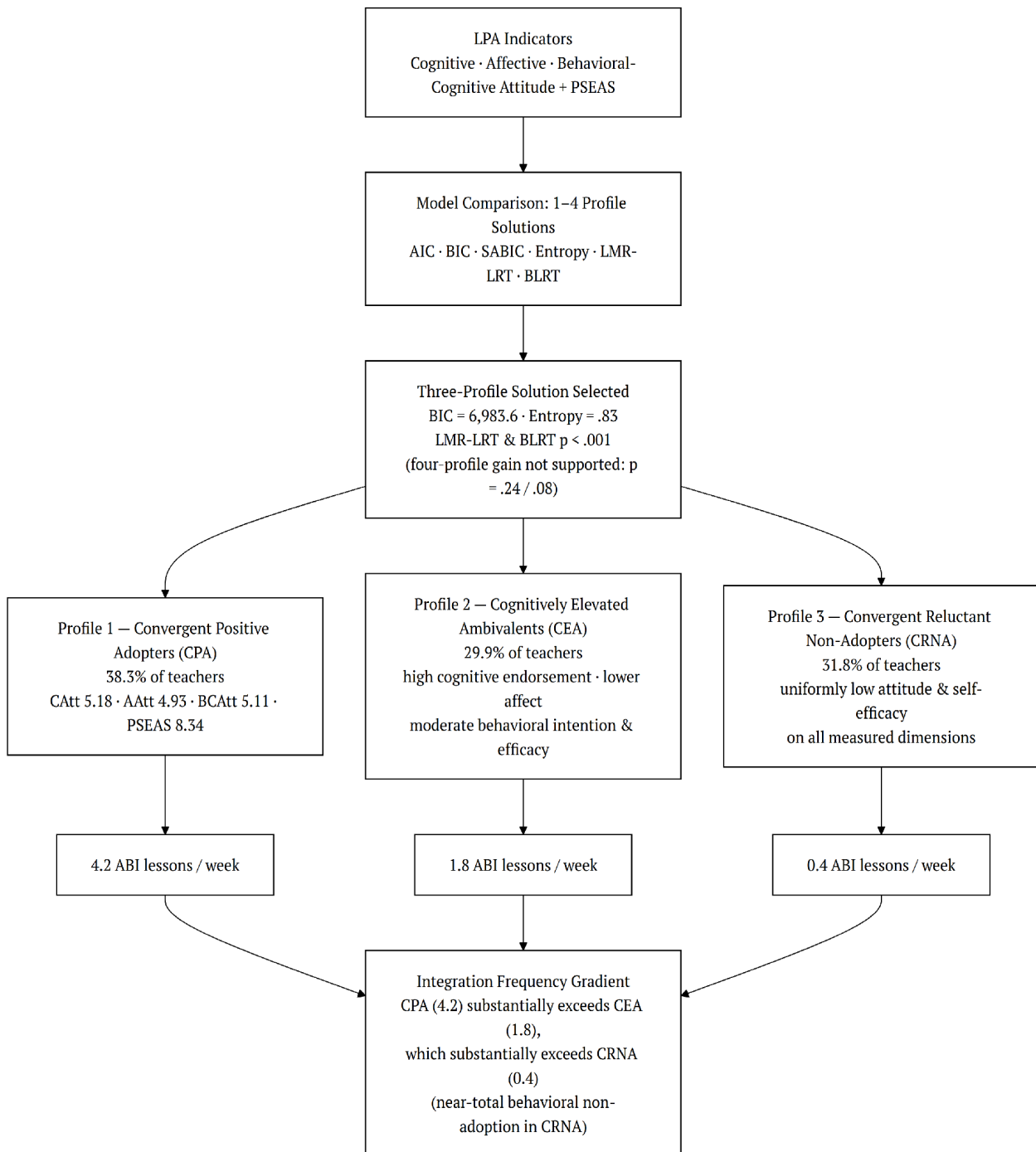


Figure 4. Latent Profile Analysis and Three-Profile Typology

Figure 4. Comparison of one- to four-profile latent solutions converges on a three-profile model (entropy = .83). The resulting Convergent Positive Adopter, Cognitively Elevated Ambivalent, and Convergent Reluctant Non-Adopter profiles differ sharply in tripartite attitude means, self-efficacy, and observed ABI integration frequency.

Table 4: LPA Model Selection Statistics (1–4 Profile Solutions)

Profile s	AIC	BIC	SABI C	Entrop y	LMR-LRT (p)	BLRT (p)
1	7,841. 2	7,873. 4	7,853. 1	—	—	—
2	7,203. 7	7,264. 1	7,223. 6	.81	< .001	< .001
3	6,894. 1	6,983. 6	6,921. 9	.83	< .001	< .001
4	6,882. 4	7,001. 1	6,917. 2	.78	.24	.08

The three profiles were characterized as follows, with all subscale means reported on the original six-point TAAS scale and the PSEAS on its 0–10 confidence scale.

Profile 1: Convergent Positive Adopters

These teachers had consistently high scores on all three tripartite attitude components and high pedagogical self-efficacy: CAtt M = 5.18 (SD =.44), AAtt M = 4.93 (SD =.52), BCAtt M = 5.11 (SD =.47), PSEAS M = 8.34 (SD =.81). This profile describes the theoretically ideal dispositional profile for sustained ABI adoption. Enthusiastic affective engagement, strong behavioral intentions and strong effectiveness beliefs are associated with favorable cognitive appraisals of the instructional utility of ABI.

Profile 2: Cognitively Elevated Ambivalents

These teachers supported ABI instrumentally at the cognitive-evaluative level, but had lower levels of affective engagement and moderate behavioral-cognitive intentions, along with moderate self-efficacy. This cognitive-affective discrepancy projected that the tripartite model predicts what the unidimensional attitudinal measuring systematically obscures.

Profile 3: Convergent Reluctant Non-Adopters

The attitudinal scores of these instructors were uniformly poor and their self-efficacy was significantly reduced on all dimensions. This profile is primarily concerned with instructors who have deep-seated dispositional resistance to the integration of ABI as they are the adoption barrier of most pressing practical concern for educational integration. ABI integration frequency differed significantly and substantially. CPA instructors averaged 4.2 lessons per week using an ABI, CEA teachers averaged 1.8 lessons per week, and CRNA teachers averaged 0.4 lessons per week – an almost total behavioral non-adoption.

3.2.4 Multilevel Structural Equation Modelling

The three-level ML-SEM decomposed all variables into within-classroom (Level 1) and between-classroom/between-school (Levels 2–3) components, and calculated structural routes simultaneously at each level. The entire structural model showed acceptable fit: $\chi^2(312) = 614.7$, CFI = .957, TLI = .949, RMSEA = .054 [90% CI: .047, .061], SRMR(within) = .063, SRMR (between) = .081. At Level 2, all three components of tripartite attitude had significant independent beneficial effects on ABI Adoption Intention. The highest direct influence was seen for Cognitive Attitude ($\beta = .41$, SE = .07, $p < .001$), followed by Behavioral-Cognitive Attitude ($\beta = .38$, SE = .08, $p < .001$) and Affective Attitude ($\beta = .29$, SE = .09, $p < .001$). The tripartite attitudinal composite accounted for 58.3% of the variance in ABI Adoption Intention at Level 2 ($R^2 = .583$). The indirect effect of Cognitive Attitude on ABI Adoption Intention via Pedagogical Self-Efficacy was significant and substantively meaningful: $\beta_{\text{indirect}} = .18$, SE = .04, 95% CI [.11, .26], $p < .001$. The indirect path of Affective Attitude through self-efficacy was also significant: $\beta_{\text{indirect}} = .12$, SE = .04, 95% CI [.05, .19], $p = .002$. The mediation results confirm that attitudinal orientation, even if evaluatively positive, does not automatically translate to adoption intention without activating mediation of efficacy beliefs, a finding consistent with Social Cognitive Theory and extending its explanatory architecture to the ABI adoption context specifically. The effect of PEOU was comparatively stronger than what is usually observed in high-infrastructure contexts, which is consistent with the SLR finding that PEOU predominates in resource-constrained teaching environments.

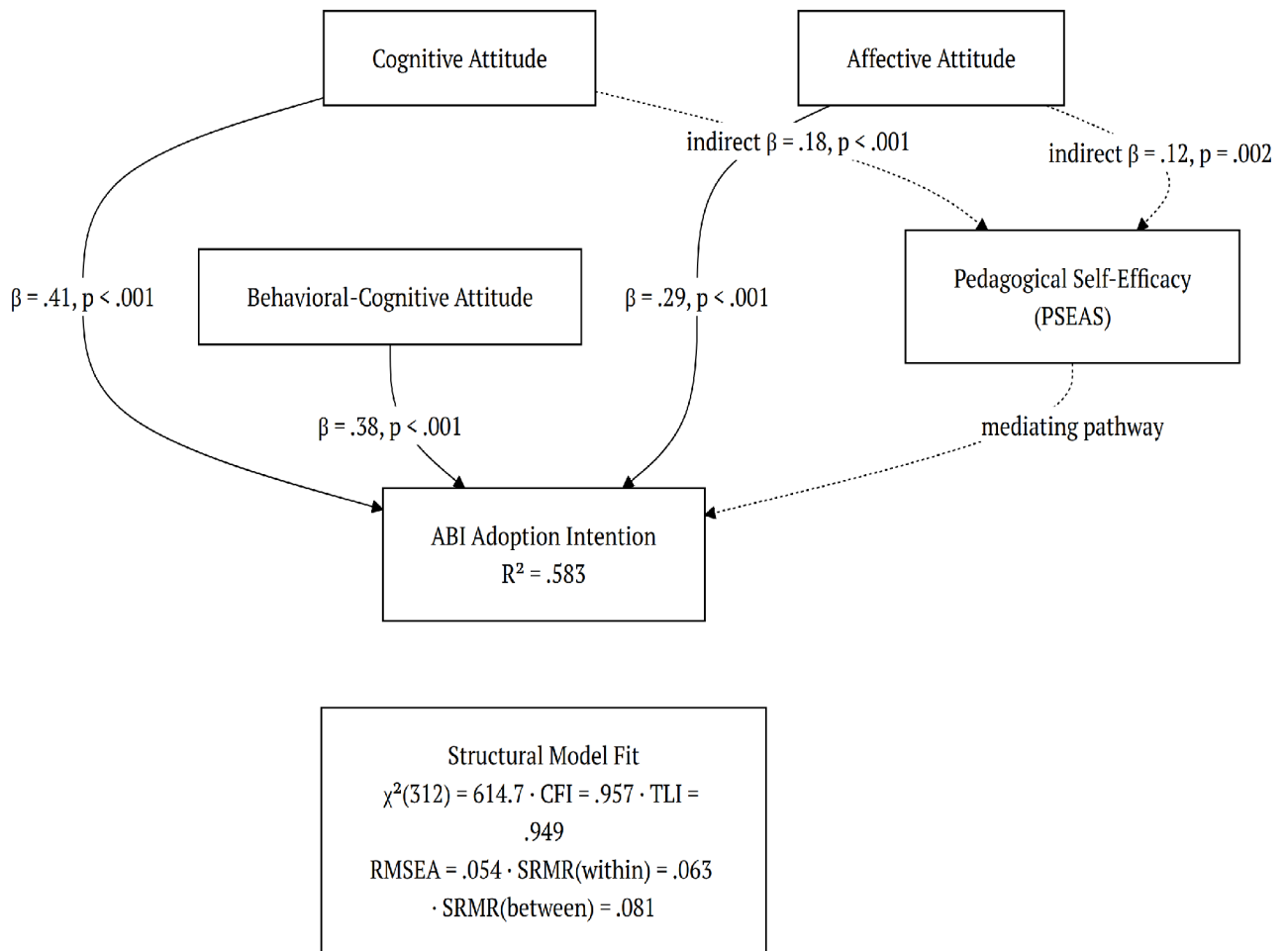


Figure 5. Structural Path Model

Figure 5. Standardized path coefficients from the three-level ML-SEM showing the direct effects of cognitive, affective, and behavioral-cognitive attitude on ABI Adoption Intention ($R^2 = .583$), together with the significant indirect effects transmitted through Pedagogical Self-Efficacy (PSEAS).

Supplementary structural models exploring the moderating effect of PSEAS included profile membership (CPA, CEA, CRNA) as a categorical Level 2 predictor. The interaction term (Tripartite Attitude Composite \times PSEAS) was significant ($p < .001$) and explained an extra 7.4% of variance in adoption intention ($\Delta R^2 = .074$). In particular, the positive structural path from tripartite attitude composite to ABI Adoption Intention was significantly stronger among teachers high in PSEAS ($\beta = .54, p < .001$) than among teachers low in PSEAS ($\beta = .21, p < .01$), supporting the argument that efficacy beliefs serve as a crucial amplifier of attitudinal disposition in the adoption process.

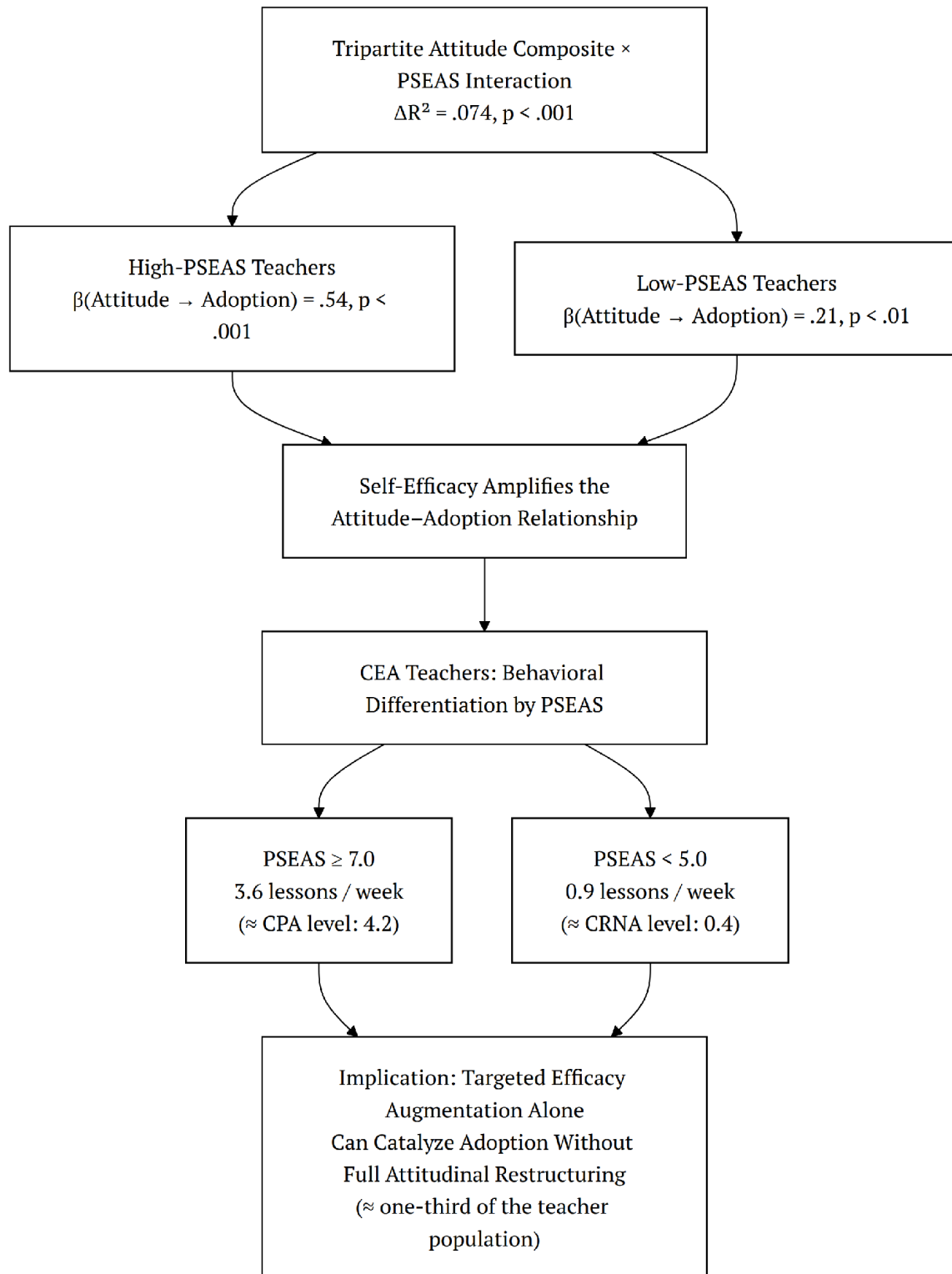


Figure 6. Self-Efficacy on Attitude–Adoption

Figure 6. The Tripartite Attitude × PSEAS interaction explains an additional 7.4% of variance in adoption intention. The attitude–adoption path is markedly stronger among high-PSEAS teachers, and PSEAS level behaviorally differentiates Cognitively Elevated

Ambivalent teachers toward either CPA- or CRNA-like integration frequencies.

Among CEA teachers specifically, PSEAS was the key behavioral differentiator for cognitive-affective divergence: CEA teachers with $PSEAS \geq 7.0$ had ABI integration frequencies ($M = 3.6$ lessons/week) similar to CPA teachers ($M = 4.2$), while CEA teachers with $PSEAS < 5.0$ had frequencies approaching those of CRNA teachers ($M = 0.9$ vs. 0.4). The implications of this findings are that approximately one-third of teachers who hold instrumentally positive but affectively ambivalent orientations toward ABI, a targeted efficacy augmentation was sufficient for them to catalyze behavioral adoption without the need for a full attitudinal restructuring. This outcome has significant implications for the design and prioritization of professional development interventions.

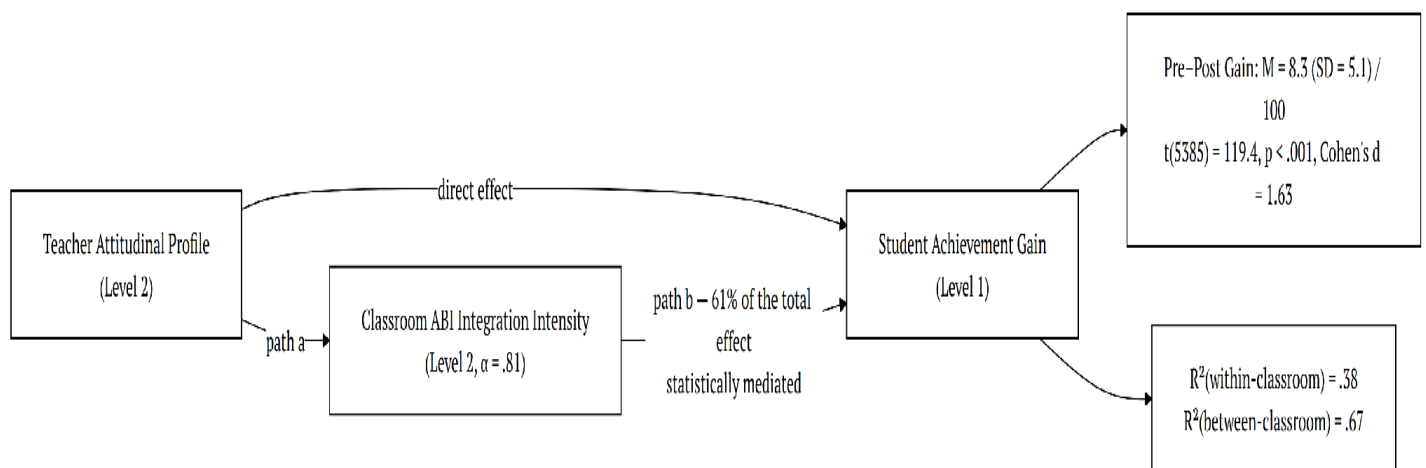


Figure 7. Cross-Level Mediation Model

Figure 7. Classic mediation pathway showing that 61% of the total effect of teacher attitudinal profile (Level 2) on student achievement gain (Level 1) is statistically transmitted through classroom-level ABI integration intensity, which jointly explains 38% of within-classroom and 67% of between-classroom variance in achievement gain.

Descriptive statistics on the AOAS indicated that student affective reactions to ABI were largely favorable, but varied internally across the three affective categories. Achievement feelings, especially enjoyment, were the most highly endorsed affective category. On the other hand, technology anxiety ($M = 3.14$, $SD = .91$) was scored below the middle of the scale (3.5), showing that most students did not find the ABI-integrated basic English classroom to be aversive. To estimate the effect size of the classroom-level effect of teacher attitudinal profile on student affective experience, Cohen’s d was calculated to

estimate the magnitude of affective differences between students in CPA teacher classrooms (high-integration condition) and students in CRNA teacher classrooms (low-integration condition):

Table 5: Affective Outcome Effect Sizes Across Teacher Attitudinal Profile Conditions

Affective Dimension	<i>M</i> (CPA Class)	<i>M</i> (CRNA Class)	Cohen's <i>d</i>	Interpretation
Achievement Enjoyment	5.31	4.14	1.23	Large
Academic Pride	4.72	3.87	0.97	Large
Epistemic Curiosity	4.89	3.98	1.04	Large
Technology Anxiety	2.84	3.57	-0.81	Large
Academic Boredom	1.97	2.79	-0.89	Large

All impact sizes were in the wide range ($|d| > 0.80$), suggesting that teacher attitudinal profile, as defined here by the quality and frequency of ABI integration in the classroom, is a strong predictor of the affective ecology of primary EFL instruction. The negative *d* values for technology anxiety and boredom provide evidence that classrooms with high-quality ABI integration, delivered by CPA teachers, correlate with significantly lower levels of technology-related negative affect, directly counteracting deficit-oriented assumptions about Bangladeshi primary learners' technological readiness.

Affective Outcome Effect Sizes: CPA-Taught vs. CRNA-Taught Classrooms

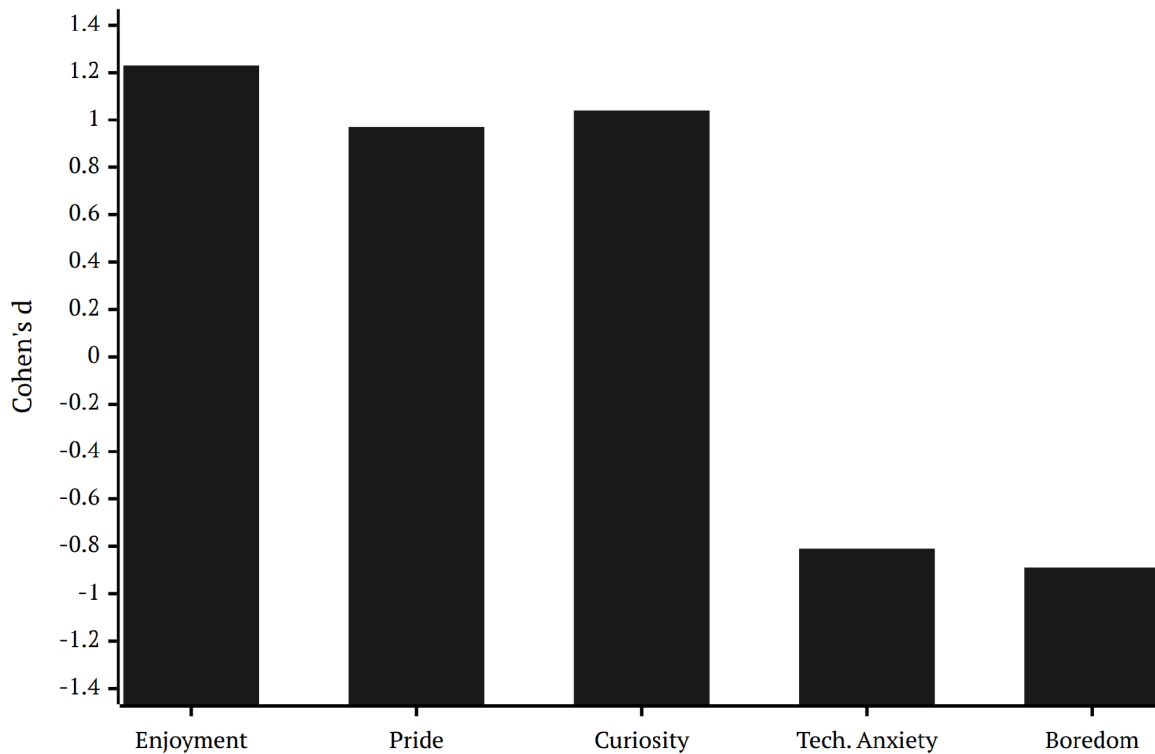


Figure 8. Student Affective Outcomes

Figure 8. Cohen's d comparing students in Convergent Positive Adopter (CPA) classrooms against students in Convergent Reluctant Non-Adopter (CRNA) classrooms across five affective dimensions. All differences are large in magnitude ($|d| > 0.80$), with positive emotions elevated and technology anxiety/boredom reduced under high-integration teaching.

Also, the paired-samples t-test of the pre-test and post-test AAPE scores for students in ABI-condition classes (collapsed across all teachers) revealed a substantial aggregate mean gain: M gain = 8.3 points ($SD = 5.1$) out of 100, $t(5385) = 119.4$, $p < .001$, Cohen's $d = 1.63$. However, this aggregate finding concealed substantial cross-classroom variation (achievement gain $ICC = .31$, Table 1) provided the motivation for the cross-level mediation analysis. A cross-level mediation model was tested to examine whether the effect of teacher profile membership (L2) on student achievement gain (L1) was mediated by classroom-level ABI integration intensity (L2) operationalized as a composite of weekly ABI lesson frequency, lesson log quality ratings, and bi-weekly observation engagement scores ($\alpha = .81$). The model explained 38% of the within-classroom variance ($R^2_{L1} = .38$) and 67% of the between-classroom variance ($R^2_{L2} = .67$) in student achievement gain,

indicating that the multilevel model significantly accounts for the classroom-level ecology of academic outcome differences in ABI-integrated primary English instruction.

3.3 Qualitative Findings

3.3.1 Perceived Instructional Affordances of ABI

Teachers in all three profiles, including a small number of CRNA teachers, recognized the instructional affordances of ABI at a cognitive-evaluative level, most often recognizing its ability to make abstract English concepts visible and simultaneously accessible to learners whose metalinguistic resources are inadequate for form-focused symbolic instruction. CPA and CEA teachers offered specific language affordances, such as vocabulary contextualization, phonological modelling, and grammatical scaffolding via visual narrative, but CRNA teachers were more likely to provide qualified appraisals based on curricular alignment or technical reliability. The structural contingencies that contextualize endorsement in the context of appreciating ABI’s potential, together with the systematic conditionality of CRNA teachers’ cognitive assessment, conform to the pattern of pragmatic cognitive attenuation commensurate with their quantitative profile characteristics.

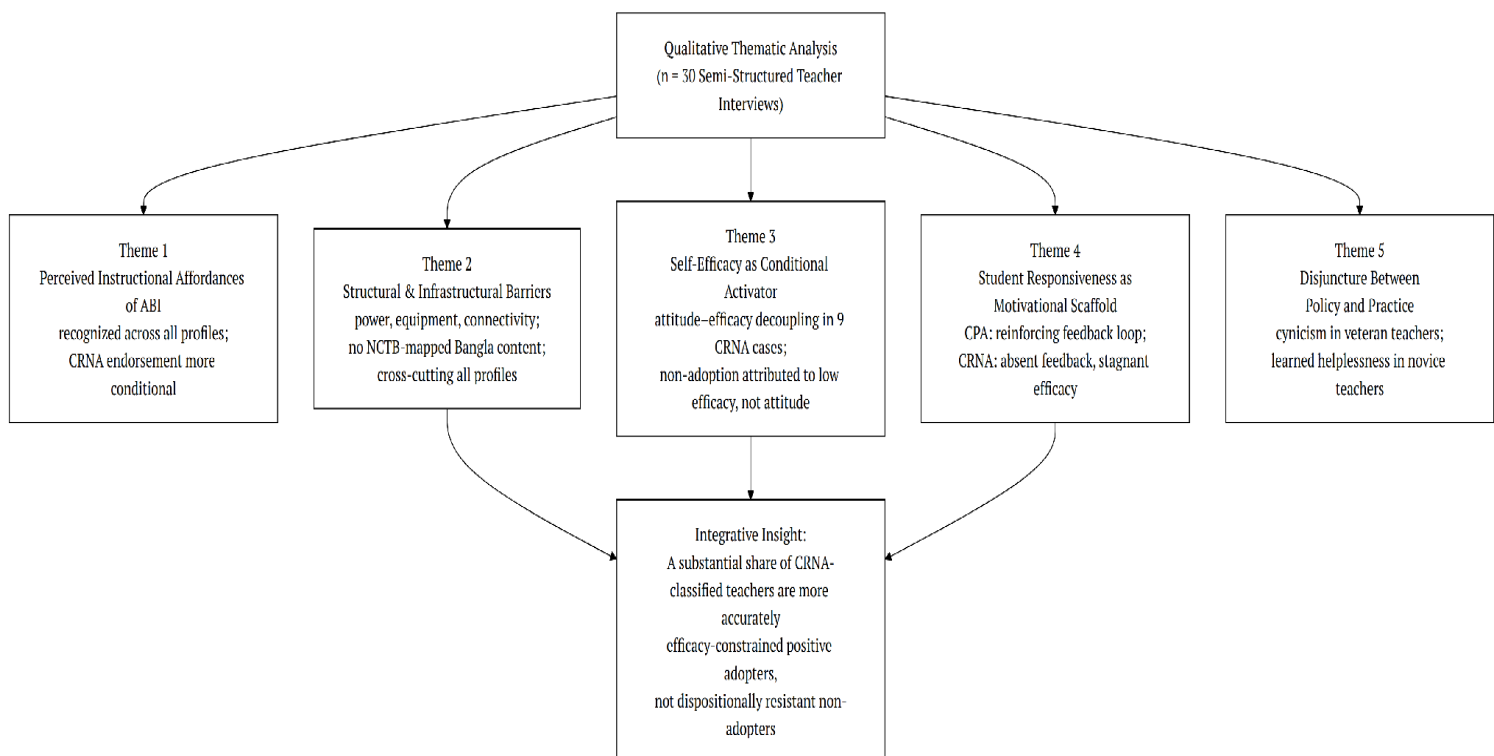


Figure 9: Thematic Structure of the Qualitative Findings

Figure 9. Five themes emerging from thematic analysis of 30 teacher interviews: perceived instructional affordances, structural/infrastructural barriers, self-efficacy as a conditional activator, student responsiveness as a motivational scaffold, and the policy–practice disjuncture. Themes 2–4 converge on the integrative insight that many ostensible non-adopters are efficacy-constrained rather than dispositionally resistant.

3.3.2 Structural and Infrastructural Barriers to ABI Integration

This was the most heavily coded theme across all profile categories, which demonstrated that structural hurdles to ABI integration are a cross-cutting limitation, not reducible to attitudinal orientation. Infrastructural Deficiency Teachers of all profiles identified unstable electrical supply, absent or malfunctioning projection equipment, limited broadband connectivity and insufficient device availability as the key deterrents. The materiality of this limitation was described as experientially crucial and qualitatively different from attitudinal ambivalence. Moreover, teachers, particularly those from CEA and CRNA, experienced a significant content-development burden, as there was no NCTB-mapped animated content in Bangla-medium or bilingual formats matching the curriculum. Most teachers described this content-development burden as impossible to handle with their current workloads. Furthermore, institutional-level impediments exacerbating individual-level limits included administrative apathy, lack of equipment maintenance practices, and lack of protected professional development time for ABI skill-building.

3.3.3 Self-Efficacy as a Conditional Activator of Attitudinal Potential

This theme provides the richest development of the quantitative interaction result (RQ3) in terms of experience. CPA teachers repeatedly expressed that beyond willingness or positive attitudinal orientation, a precondition to sustained adoption was a sense of design competence – the experienced confidence that one can develop, choose, adapt, and iteratively modify animated sequences with. In contrast, the CRNA teachers often reported that they did not adopt their non-adoption due to negative attitudes but rather weak self-efficacy, a pattern of attitude-efficacy decoupling that is the most clinically important finding for professional development design. The finding, replicated across 9 CRNA-profile participants with varying degrees of explicitness, suggests that the convergent negative quantitative profile of CRNA teachers may partially misclassify teachers who are attitudinally receptive but efficacy-constrained, rather than dispositionally resistant, with direct implications for targeted intervention design.

3.3.4 Student Responsiveness as a Motivational Scaffold

CPA teachers indicated that the observable student behavioral and affective engagement during ABI-mediated lessons served as a significant self-reinforcing feedback mechanism that sustained their adoption motivation throughout the academic year. In contrast, CRNA teachers described limited exposure to student participation during ABI. In a self-reinforcing cycle of avoidance and absence of positive feedback, CRNA teachers were not able to access the motivational stimulus that might have iteratively moved their self-efficacy beliefs upward.

3.3.5 Disjuncture between systemic policy and practice

Most eloquently across participants from CEA and CRNA, and across all profile types of teachers, was a description of a systematic contradiction between the national policy demand for digital integration and the material realities of their schools. Attitudinal cynicism resulted from this dissonance for experienced instructors, and a kind of learned helplessness for fresher teachers who had internalized systemic failure as a normative expectation. The policy-practice divide, theorized as an abstract structural phenomena, appeared in interview data as a very personal and professionally demoralizing experience.

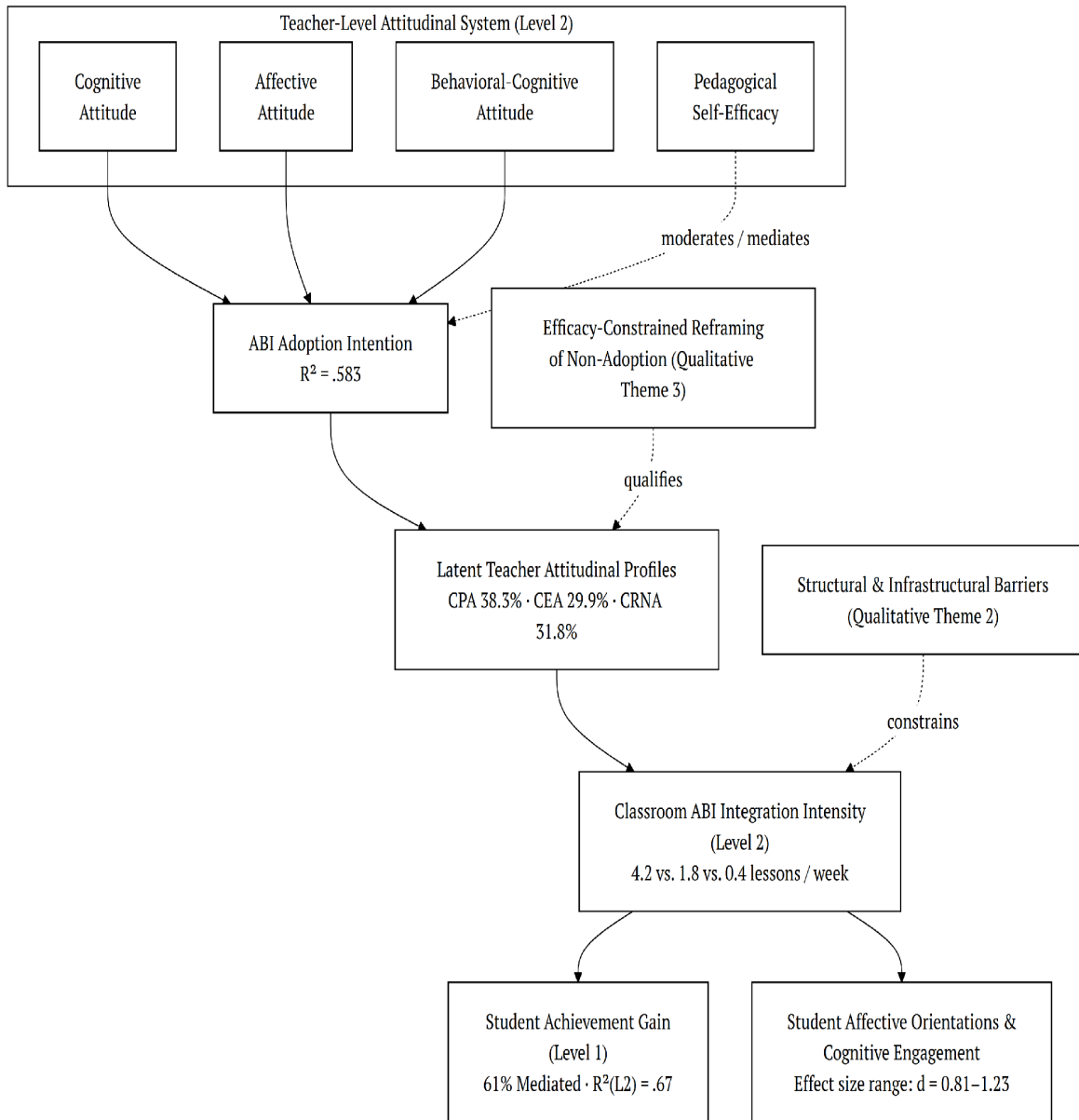


Figure 10: Integrated Multilevel Conceptual Model Synthesizing the Findings

Figure 10. Graphical synthesis tracing the full multilevel pathway documented in Section 3: teacher tripartite attitudes and self-efficacy jointly predict ABI Adoption Intention; adoption intention differentiates latent teacher profiles; profile membership drives classroom ABI integration intensity (qualified by structural barriers and the efficacy-constrained reframing of non-adoption); and integration intensity in turn predicts student achievement gain and affective/cognitive engagement outcomes.

4. DISCUSSION

4.1 Teacher Attitudinal Tripartition and ABI Adoption

The major contribution of this study is the empirical confirmation of the proposition that attitude is a multidimensional dispositional system, not a unitary evaluative tendency, where all three tripartite attitude components, i.e., cognitive, affective and behavioral-cognitive predict ABI adoption intention as significant in a South Asian primary EFL context. The notable indirect influence of cognitive attitude on adoption intention mediated by PSEAS ($\beta_{\text{indirect}} = 0.18$) contributes to the theoretical explanation of the attitude-behavior gap identified in the educational technology adoption literature. This provides an empirical testimony that efficacy is the proximal determinant of action, applied for the first time in the tripartite-attitude architecture of ABI adoption research. It confirms that even very positive cognitive appraisals of the instructional utility of ABI do not directly translate into behavioural intention unless they are accompanied by strong self-efficacy beliefs. This finding has immediate practical implications. Professional development programs that only invest in persuasive demonstrations of ABI's instructional effectiveness, but do not also build teachers' self-efficacy for design and deployment has the potential to generate attitude shifts that are behaviorally inert.

4.2 Classroom ABI as the proximal mediator of achievement (RQ1)

The most important structural result of this study from a theoretical and practical point of view is the cross-level mediation finding that 61% of the entire effect of teacher attitudinal profile on student achievement increase is explained by classroom-level ABI integration intensity. It conceptually clarifies how ABI integration functions as the structural process via which dispositional orientations translate into measurable academic outcomes, proposing instructional behavior, rather than attitudinal orientation, as the proximal lever of change in learning. In practice, policies and programs for attitude change will only yield advances in success if they simultaneously bring about and sustain changes in classroom instructional practice. The substantial cross-classroom variance in both ABI integration intensity and student achievement gain affirms that the classroom is the most consequential organisational level for ABI-related academic outcomes – an empirical finding that justifies investing in classroom-level rather than institutional-level interventions as the highest-leverage policy target. The multilevel model explained 67% of between-classroom variance in achievement gain, indicating that teacher attitudinal profile, self-efficacy and classroom integration intensity jointly offer a strong explanatory

framework for understanding why some primary EFL classrooms yield much better English learning outcomes than others.

5. IMPLICATIONS FOR PRACTICE

5.1 Implications for National Level Educational Policy

The cross-level mediation results verify that attitudinal modification without the corresponding material investment in ICT infrastructure would lead to poor academic outcomes. The Directorate of Primary Education and the Ministry of Primary and Mass Education must therefore pursue an explicitly two-track investment strategy: (a) systematic, sustained ICT infrastructure development, i.e., reliable power supply, maintained projection equipment and bandwidth-adequate internet connectivity as a material prerequisite for ABI deployment across all locations; and (b) structured, differentiated attitudinal and efficacy development programs for primary English teachers as a prerequisite for sustained ABI integration. The 31.8% CRNA teacher representation in the current sample suggests that approximately one in three of the primary English teachers in the study region is a near-complete non-adopter of ABI, which is a proportion that constitutes a huge and remediable waste of the potential academic benefit.

5.2 Teacher Education and Professional Development Implications

The three-profile LPA typology offers a theoretically informed and empirically grounded basis for the diversified design of ABI professional development programs. A one-size-fits-all strategy to training is unlikely to be beneficial for a teacher population distributed among three dispositionally varied attitudinal profiles with fundamentally differing developmental needs.

The first steps in intervention for CRNA teachers are behavioral activation and affective engagement. Experiential workshops demonstrating the effectiveness of ABI in teaching, even in low-infrastructure settings, together with structured peer observation of CPA teachers, can pave the way for self-efficacy building through mastery experience and reinforcement. Targeted design and deployment self-efficacy augmentation through supported planning exercises collaborative content identification and scaffolded ABI lesson delivery, which is the highest-yield intervention for CEA teachers, the highest-leverage target for investment in professional development. As the PSEAS interaction effect shows efficacy augmentation in this group, it is sufficient to activate behavioural adoption without requiring full attitudinal restructuring. Professional development for CPA instructors should focus on building and extending integration quality through collaborative lesson planning

communities, peer observation protocols, and access to curated, curriculum-aligned ABI content libraries.

5.3 Curriculum Design Implications and Development of ABI Content

The curriculum-technology mismatch identified in qualitative Theme 2b and corroborated by the TAM-ABI PEOU finding establishes that the absence of NCTB-aligned, primary-appropriate animated English content is a structural impediment to ABI adoption that cannot be surmounted by individual teacher motivation and professional development. A centralized, freely accessible digital repository of curriculum-mapped, pedagogically validated animated English lessons, collaboratively developed by curriculum specialists, ELT methodologists, educational technologists, and bilingual content experts, and peer-reviewed against CTML design principles, would go a long way in alleviating the content-development burden that currently serves as a prohibitive point of friction for the CEA and CRNA teacher populations.

6. Conclusion

This study is the first multilevel empirical study of primary English teachers' attitudinal orientations towards ABI in a South Asian context and at the same time, a methodologically comprehensive study to investigate the five core constructs of ABI simultaneously, i.e., tripartite attitudes, adoption intention, pedagogical self-efficacy, student affective orientations, and academic achievement outcomes within a three-level analytical framework. It makes five main empirical contributions as follows. First, it reveals the tripartite structure of teacher attitudes toward ABI and the non-redundant predictive effects of the three components on adoption intention, with cognitive appraisal serving as the main gateway, behavioral-cognitive intention as the proximal drive and affective orientation as an enabling amplifier. Second, the LPA identifies three empirically distinct attitudinal profile types—Convergent Positive Adopters (38.3%), and Convergent Reluctant Non-Adopters (31.8%) which differ substantially in ABI integration behavior that cannot be identified through unidimensional attitudinal measurement. Third, the cross-level mediation analysis shows that 61% of the effect of teacher attitudinal profile on student achievement increase is mediated by classroom-level ABI integration intensity, pointing to classroom instructional behavior as the primary proximal mechanism. Fourth, student affective orientations in ABI-integrated classrooms are overwhelmingly positive with large effect size differences across teacher profile conditions, demonstrating that teacher adoption behavior structures. Fifth, the integration of quantitative and qualitative findings reveals

that structural barriers are universal across profile types. It also demonstrates that self-efficacy serves as an activation threshold for attitudinal disposition especially among CEA teachers and teachers classified as CRNA who are more appropriately understood as efficacy-constrained positive adopters.

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