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Family Lingo: A Tri-Generational Participant Analysis of a Mobile-Mediated English Language Acquisition Intervention for Generation Z Learners in Tamil Nadu, India

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Abstract. This three-year mixed-methods study made use of Tri-Generational Participant Analysis (TGPA) to investigate the four-pillared English language intervention program named Family Lingo, which consists of gamified mobile learning, structured online courses, peer mentoring, and literary competitions among 383 Generation Z students aged between 13 and 18 years from 18 districts of Tamil Nadu, India. In TGPA, family members from at least two generations are recruited for joint observation and participation in research on language

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acquisition. The convergent parallel approach used the Common European Framework of Reference for Languages-based proficiency tests, Family Attitude toward English Scale, and app analytics along with reflexive thematic analysis of family linguistic interaction diaries, mentor logs, and family participatory debrief sessions. Repeated-measures analysis indicated medium, significant gains in English proficiency across all four skill domains from baseline to month 36 (Cohen's $d = 0.55-0.65$, $p < .001$), evenly distributed among government-rural, government-semi-urban, and private-urban learners ($p > .09$). The family-level identity threat was reduced by 69.5% and 81.4% of the coded qualitative data units were positive toward the intervention. Baseline family attitudes were not related to the size of individual gains, indicating that the intervention itself, rather than pre-existing family attitude, was the primary contributor to improvement. The results support the family-embedded intervention design as a viable, equitable model for English language development in multilingual, resource-heterogeneous contexts.

Keywords: English language acquisition; family language policy; gamification; Generation Z; India; longitudinal study; mixed-methods research; mobile-assisted language learning; peer mentoring; Tri-Generational Participant Analysis

1. Introduction

In India, English is situated at the top of the sociolinguistic hierarchy and is the language of higher education, job opportunities and digital inclusion. Years of compulsory English instruction, as per India's three-language policy, have not led to English proficiency among the majority of Indians, in particular Generation Z learners in semi-urban/rural India. India's 2020 National Education Policy explicitly acknowledges this deficit and identifies technology-driven learning as an effective approach to address this gap. Implementation, however, has been sporadic and inconsistent (Singh, 2025).

Generation Z comprises individuals born between 1997 and 2012. This generation is the first to grow up in the era of touch screens, algorithmic information delivery, and digital interaction with their peers. The conventional methods of teaching, such as grammar-based rote learning, isolated reading, and the chalk-and-talk teaching method, do not align with the way this generation learns; hence the emergence of mobile-assisted language learning (MALL). The research on MALL has grown rapidly since 2000, with the most studied modalities being vocabulary acquisition and gamified applications (Duman et al., 2015), and evidence is emerging that gamified applications are associated with increased motivation and engagement.

However, a methodological lacuna still exists in the realm of MALL: learners have traditionally been studied as individual autonomous units, while the social setting has hardly been operationalized as a research variable. This is not ecologically valid because learning a language does not happen in isolation; especially in the South Asian context, it happens amid the social milieu, with the

ideological orientations of family members with respect to the target language being one of the factors that constitute acquisition (Curdtt-Christiansen et al., 2023; Sevinç & Mirvahedi, 2023). Acquisition is inhibited by ambivalent or antagonistic orientations and facilitated by the social spaces in which family members use English (Taguchi, 2005).

Learning is inherently a social process mediated by learners' interactions with those more capable within the zone of proximal development (Vygotsky, 1978). In the same vein, Bronfenbrenner's (1979) theory of ecological systems places the learner within multiple social systems: 1) family, school, and peers; 2) interaction between the two; 3) community; 4) cultural and political environment. Family involvement remains a consistent predictor of academic success irrespective of socioeconomic categories (Barnes et al., 2024).

Two more pillars of the Family Lingo Framework are based on related bodies of literature. The pillar of structured peer mentoring, where university mentors tutor learner groups from Generation Z, is built on findings that near-peer relations promote motivation, reduce language anxiety, and improve communication confidence (Ling & Huang, 2024). Literature competitions (storytelling, poetry writing, spoken word, debating, drama, and essay writing) involve affect-laden and risky production activities. Public performance has been found to increase willingness to communicate and integrative motivation (Yashima et al., 2018).

The methodological contribution of this paper is Tri-Generational Participant Analysis (TGPA) involving parents, grandparents and siblings as co-participants, co-observers and co-evaluators in the research design. TGPA uses five purpose-developed instruments to collect longitudinal data on the family's linguistic ecology and learner proficiency trajectories: the Family Linguistic Interaction Diary (FLID), Family Language Map (FLM), Family Narrative Elicitation Task (FNET), Family Attitude toward English Scale (FATES), and structured family participatory debrief sessions (FPDS). The instruments are based on linguistic ethnography (Rampton et al., 2004) and participatory action research (Kemmis et al., 2014).

2. Literature Review

The FamilyLingo framework is situated at the intersection of six areas of scholarship: MALL and gamification; Generation Z as a digital-native learner population; family language policy and sociocultural theory; English language education in India; parental and family involvement; and mixed-methods and participatory research design.

2.1 Mobile-Assisted Language Learning and Gamification

In the past two decades, MALL has been one of the most researched topics in applied linguistics due to inexpensive smartphones that can provide instruction in situ and at any time. The bibliometric analysis of articles on MALL research from 2000 to 2012 showed progressive advancements in vocabulary and listening but also relatively less development in speaking and writing (Duman et

al., 2015). Current research has been taking mobile learning in the direction of learner agencies and the social aspect of mobile learning, examining how new technologies impact learners' relationship with language, community, and identity (Kukulska-Hulme, 2021).

A systematic study of 87 papers on MALL and gamified language learning showed that mobile learning has a positive impact on students in terms of engagement, vocabulary, and grammar proficiency; however, the absence of social-contextual variables remains persistent in MALL research designs (Ishaq et al., 2021). What differentiates MALL from other approaches is its portability, networking, contextual awareness, and asynchronous communication opportunities (Li et al., 2023). The literature review of engagement methodologies over the last two decades showed significant construct heterogeneity and a need for longitudinal frameworks (Hiver et al., 2024).

Gamification refers to the process of including game-design techniques such as rewards, levels, competition, and narrative immersion into nongame settings and has been studied extensively as a motivational intervention in foreign-language teaching and learning. A systematic review of 38 articles showed the positive impact of gamification on motivation, engagement, and vocabulary acquisition and described competition, narrative immersion, and immediate feedback as the most influential mechanics (Dehghanzadeh et al., 2021). In a meta-analysis of 85 studies, a moderate positive impact on academic performance was revealed ($d = 0.52$), which increased with comprehensive designs (Zeng et al., 2024).

More durable motivation was found to be elicited among adolescent learners through culturally grounded, narrative-based tools than through abstract point systems (Luo, 2023), with the greatest skill gains in speaking fluency (Zhang & Hasim, 2023). These findings highlight a conflict in the literature whereby engagement- and mechanics-based approaches (Li et al., 2023; Zhang & Hasim, 2023) consistently yield positive outcomes related to motivation and skill development, whereas systematic reviews (Hiver et al., 2024; Ishaq et al., 2021) reveal at the same time that social-contextual factors, such as the family, are often neglected in MALL studies. This disparity between proven effectiveness and an overlooked context serves as a major impetus behind the present study.

2.2 Generation Z as a Digital-Native Learner Population

Generation Z students have been raised with digital and networked media, which has influenced their cognitive preferences and motivation orientations. Digital media has encouraged collaboration and experiential learning rather than passive learning approaches (Cilliers, 2017). The design of digital media has engaged users through its diversity, inclusiveness, technology and output orientation (Pichler et al., 2021). A discrepancy needs to be pointed out in this context: while digital literacy is associated with engagement in technology mediated instruction, it is not associated with self-regulated learning (Alruthaya et al., 2021), which makes the optimism regarding Generation Z as inherently good learners slightly questionable (Cilliers, 2017).

2.3 Family Language Policy and Sociocultural Theory of Second Language Acquisition

Within this triad, identity threat refers to the perception that using or valorizing a majority/target language (here, English) endangers one's heritage-language identity or cultural belonging; this construct, later operationalized as one of the five FATES subscales (Section 4.4) and central to the results reported in Sections 5 and 6, is grounded directly in this pride-prejudice-pragmatism framework rather than introduced without theoretical basis.

Language awareness and language decision-making in family settings, the triad of pride-prejudice-pragmatism as applied specifically to the Indian case, and the inherent conflict between the pride of heritage languages, stigma of minority language speakers, and pragmatism of using the majority language (Curd-Christiansen et al., 2023) are highly significant theoretical concepts for the FamilyLingo framework. The family members' emotional reaction to the language used—anxiety, pride, shame—predict target language retention (Sevinç & Mirvahedi, 2023). An affective climate characterized by celebration of achievements rather than corrections correlates with better retention rates (Zabrodska et al., 2024).

Family involvement in language learning is supported theoretically by combining the ideas of Vygotsky (1978) and Bronfenbrenner (1979). When families are positive about the language learning process and give ample opportunities for English usage, acquisition rates are much higher (Taguchi, 2005). Lambert's (1974) distinction between instrumental and integrative motivation means that family involvement predicts better integrative motivation and thus deeper acquisition. Otero-Mayer et al. (2025) demonstrated that ecological fit in the family, school and community predicted better language acquisition than intervention in any single setting. Contrastingly, in the two latter cases (Sevinç & Mirvahedi, 2023; Zabrodska et al., 2024), the emotional/affective tone of the family comes to be seen as the central determinant, whereas in the case of Taguchi (2005) and Lambert (1974), the issue of family impact is considered more structural, via the dimensions of opportunity and motivational disposition. Both aspects are combined in the TGPA.

2.4 English Language Education in the Indian Context

India has a sociolinguistic hierarchy in which English stands at the top of the institutional hierarchy. Although the three-language formula requires learning English along with the regional language and Hindi, the actual implementation varies widely. While private-urban schools tend to produce near-native competence, rural government schools often produce learners who are literate but not fluent in spoken English. This gap is recognized in policy, but evidence of robust intervention is still lacking (Singh, 2025). This disconnect between policy aspiration and implementation (sSingh, 2025) is exactly the fissure that a family-embedded, longitudinally measured intervention such as FamilyLingo is designed to fill.

2.5 Parental and Family Involvement in Education

Longitudinal and meta-analytic work suggests a reliable positive relationship between parental involvement and both academic and social development in early childhood and elementary school (El Nokali et al., 2010; Ma et al., 2016) and is robust to control socioeconomic confounds (Kantova, 2024). Despite this evidence base, family involvement has seldom been formalized as an active variable in MALL designs. The paradox that forms the foundation of the current research is the following: there is sufficient evidence of the effectiveness of involving families in language learning (El Nokali et al., 2010; Kantova, 2024; Ma et al., 2016); however, a relevant quantitative variable for MALL interventions has not yet been developed.

2.6 Mixed-Methods and Participatory Research Design

The specific approach of the convergent parallel design allows gathering and merging quantitative and qualitative data, a well-known methodology in the field of applied linguistics (Creswell & Plano-Clark, 2018), comprising joint display analysis and typology development (Zhou et al., 2024). The qualitative part was based on reflexive thematic analysis (Braun & Clarke, 2023), which assumes the researcher is an active reflexive agent and not an objective pattern detector, thus drawing on the experience of participatory action research (Kemmis et al., 2014).

Combined, Sections 2.1 to 2.6 point to five converging lines of evidence—the effectiveness of MALL/gamification, Generation Z learners, family language policy and effect, the particular problem of implementation in India, the benefits of parental involvement, and the use of mixed-methods/participatory design—as well as to one consistent lack: not one line of evidence considers multigenerational family involvement as a factor actively measured in a mobile-assisted intervention. FamilyLingo attends to the two former lines of evidence in its four pillars of intervention, and to the three latter lines of evidence in its TGPA, which is the first toolkit for measuring families as participants in an intervention.

It can be seen from the above literature how the convergence of evidence about the benefits of the mobile-assisted, gamified, family-related, and ecologically oriented approaches to second language acquisition is shown. However, there is one thing that all those approaches lack: there are no studies on MALL conducted in India and developing countries that considered individuals belonging to more than one generation of a family and collected data from all generations at the same time in a longitudinal fashion. Table 1 shows TGPA's position in relation to the closest related traditions, highlighting the fact that TGPA is unique because it involves (a) concurrent data collection from three generations using five instruments designed for the purpose, (b) a 36-month longitudinal design, and (c) psychometric validation of its main attitude scale (FATES). This evidence is why the TGPA is introduced and tested using the FamilyLingo framework.

Table 1: Comparison of TGPA with closely related frameworks

Framework / Tradition	Representative Sources	Generations Involved	Family Role	Data Sources
Ecological Systems Theory	Bronfenbrenner (1979); Otero-Mayer et al. (2025)	Typically, one (child) within nested systems	Contextual influence, not co-participant	Observation of settings, not family-generated data
Family Language Policy	Curd-Christiansen et al. (2023); Sevinç & Mirvahedi (2023)	Usually parent-child (two)	Decision-makers studied retrospectively	Interviews, policy documents
Participatory Action Research	Kemmis et al. (2014)	Variable; rarely multigenerational by design	Co-researchers	Cycles of reflection/action, mixed
Parental/Family Involvement (general education)	Ma et al. (2016); El Nokali et al. (2010); Kantova (2024)	Parent-child (two)	Involvement measured as a predictor variable	Surveys, academic records
TGPA / FamilyLingo (this study)	This study	Three (learner, parent/guardian, and where possible grandparent), plus peer informants	Active co-observers and co-participants, formally enlisted and measured longitudinally	Five purpose-built instruments (FLID, FLM, FNET, FATES, FPDS) across 36 months

The literature has identified a research gap, and this study addresses five research questions:

RQ1: How much does the FamilyLingo multi-pillar intervention improve the English language proficiency of Generation Z learners over 36 months?

RQ2: How does the quality of family participation, as measured by TGPA instruments (particularly FATES), relate to the language acquisition trajectories of individual learners?

RQ3: Do learner app engagement and the perceived value of mentoring/competition predict learner self-efficacy in English?

RQ4: Are there differences in gains in proficiency, attitudinal outcomes and intervention effectiveness by school type (government-rural, government-semi-urban, private-urban) and locality (rural versus urban)?

RQ5: How do family members' attitudes to English change during the intervention period and how do the changes contribute to maintaining learner motivation?

3. Methodology

3.1 Research Design

A mixed-methods convergent parallel design (Creswell & Plano-Clark, 2018), wherein both quantitative (Common European Framework of Reference for Languages [CEFR]-based language proficiency test, FATES scores, application

analytics) and qualitative data (FLID, mentor observation logs, competition stories, and TGPA interview transcripts) were collected simultaneously and analyzed in a joint analysis process (Figure 1) during the interpretation phase, was used in this study. This design was adopted as quantitative measures alone, which might oversimplify the social complexity of the learning context, or qualitative data alone, which may not be able to produce population-level estimates for the effectiveness of the intervention program, were insufficient to capture the multidimensional process of language learning.

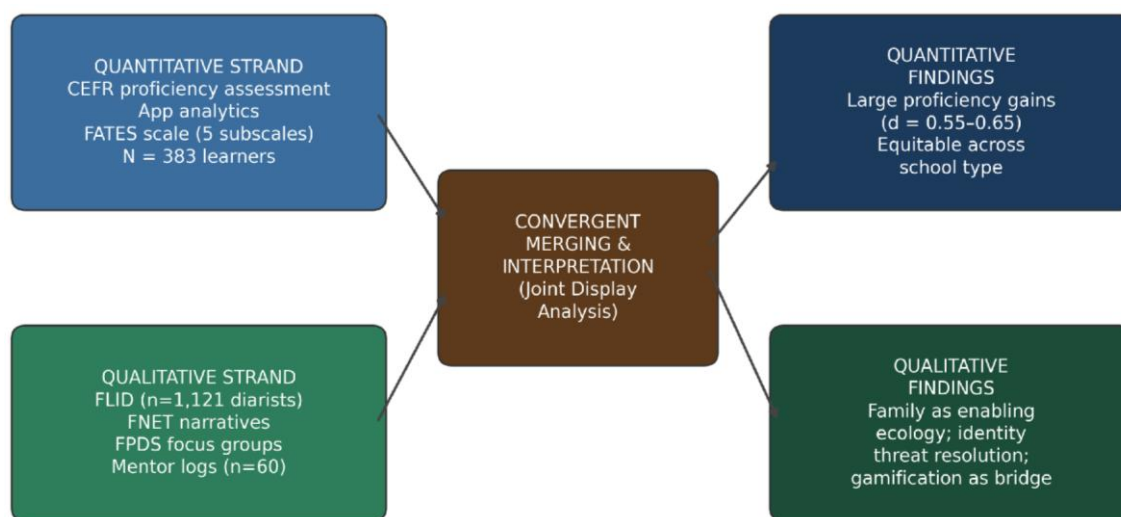


Figure 1: Mixed-methods convergent parallel design of the Family Lingo study

3.2 Participants

A total of 383 Generation Z participants, aged 13 to 18 years, from 18 districts of Tamil Nadu (government-rural $n=186$, government-semi-urban $n=135$, and private-urban $n=62$) participated in the research. The inclusion criteria included attending Classes 8 to 12, access to a smartphone, availability of two or more family members ready to become TGPA informants and a baseline CEFR level A1-B1. The baseline CEFR levels for the participants were A1 ($n=131$, 34.2%), A2 ($n=178$, 46.5%) and B1 ($n=74$, 19.3%). The districts, schools and families were mainly selected from data received from the government education department, along with snowball sampling, where the families enrolled referred us to other eligible families that met the inclusion criteria.

There was no pre-set formula or quota for reaching a sample size of 383; a total of 400 participants met the eligibility criterion of being enrolled, of which 17 were lost in the first stage due to personal reasons and treatment problems not related to the research, giving the total of $N=383$. The research setting chosen was Tamil Nadu, as there were existing mentoring relationships with the state, with the availability of a mix of rural/semi-urban/urban government/private school types within the state (which helped us compare school types as stated in Section 5). It was also chosen because the schools were easily accessible and had curriculum uniformity in teaching English. About 90% of the participants used their own devices from home (smartphones), while about 10% (38 students) were provided with devices on loan from peers or family members.

The Generation Z participants became part of a FRU comprising two to four members, with the presence of at least two generations – parents/guardians (35-65 years old) and, if possible, grandparents (65+), while their siblings could be used as peer family informants. A total of 1,121 family members remained FLID for 36 months. A total of 60 peer mentors (CEFR B2+, living nearby).

3.3 Intervention Architecture

Pillar 1 – Gamified Mobile App Learning: FamilyLingo is a mobile platform that is an Indian-themed, narrative-driven adventure world, where an Adaptive Learning Engine personalizes difficulty through engagement signals and spaced repetition. Mechanics include experience points, CEFR-linked levels, streaks, leaderboards and a “Family Quest” feature where learners earn bonus experience for teaching an English word or phrase to a family member and logging it in-app.

Pillar 2 - Structured Online Classes: Instruction happened three times a week in groups of 15 to 20 learners through a learning hub integrated with a video conference platform, led by certified English instructors working on a Cambridge A1-B1 pathway. For each month, one of the sessions was set aside as “Family Open Class” where family members were invited and encouraged to take part in simple oral activities in spoken English within their capacity, providing direct observational data of family learners’ language interaction. Family Open Class sessions were conducted as natural observations, rather than a structured protocol that had a script, rubric, and checks for inter-instructor consistency. The instructors were allowed to conduct the Family Open Classes in whatever manner they felt was most likely to engage the families in the activities.

Pillar 3: Peer mentoring: The learners were scheduled for one video session each week with their assigned peer mentors. These were not formal teachers but motivational anchors and cultural brokers who were tasked to perform family attitude probes through conversations about the family’s attitudes toward the learner’s English learning after six weeks. This yielded qualitative data, which was cross-referenced with the TGPA data collected from families. Mentors received online orientation via video conference (Google Meet) before the intervention began, when the mentoring program expectations, Family Attitude Probe procedure, and communication guidelines were explained; mentorship instructions in writing were distributed to the 60 mentors, who were assigned an average of 6.4 learners each (383 learners / 60 mentors); mentors' self-reported cohort sizes on the Module 3 questionnaire (15–22 learners) reflect their broader contact group across sessions, not this 1:1 study assignment.

Pillar 4: Literary events: For six genres, namely short stories, poetry, spoken words, debates, drama and essay writing, the winners would be selected in competitions conducted four times each year at the district, state and national levels. It was mandatory to invite the family members or watch the performances being streamed, followed by a structured reaction interview in their local language. The entries were judged against a quantitative judging

rubric, giving scores to the performances in the competition, thus allowing quantification of the competition performance with the three other intervention pillars.

3.4 Tri-Generational Participant Analysis: Instruments

TGPA is based on linguistic capital (Bourdieu, 1986), Bronfenbrenner's process-person-context-time model, linguistic ethnography (Rampton et al., 2004), and participatory action research (Kemmis et al., 2014) and was operationalized by five purpose-developed instruments.

The FLID is a weekly bilingual diary where the family documents their experiences with the learner's use of English at home, the family's reaction to such use, and the vocabulary used. The FLM is a modification of Wei's (1994) social networks approach, measured at three time points, obtaining information on who talks to whom, what is said, and the nature of emotion in interactions. The FNET is performed every six weeks: the learner narrates an English story based on a picture sequence, followed by producing a story in their native tongue by another family member, thus making discourse analysis possible against the native tongue baseline.

The FATES is an instrument that has undergone a four-stage process (expert review, cognitive interviews, Exploratory Factor Analysis [EFA], Confirmatory Factor Analysis [CFA]) using 383 family units to test validity, where Cronbach's alpha is greater than 0.78 in each subscale. The FATES contains five measures: Instrumental value, integrative value, identity threat, domestic comfort and learner support orientation. All measures are collected at baseline, 12 and 36 months. FPDS involve focus groups with four to six FRUs and occur every four months. FLID, FLM, FNET and FPDS were developed by us for this study. They were piloted with a local sample of 50 families before being used fully. The pilot helped in identifying irrelevant and vague items in the first draft questions and diary prompts, which were re-framed before being finalized.

Data were collected over 36 months across four phases: baseline (month 0; CEFR placement, FATES Wave 1, FLM Wave 1), phase 1 (month 1-12; weekly FLID, six-weekly FNET, district competitions), midpoint (month 12; CEFR re-assessment, FATES Wave 2, FLM Wave 2, state competitions), phase 2 (month 13-24), phase 3 (month 25-36; national competitions, mentor exit reviews), and end-point (month 36; final CEFR assessment, FATES Wave 3, FLM Wave 3, exit interviews).

3.5 Ethical Issues

Because of the participation of children, a two-step consent process was conducted: written consent from the parents or guardians and assent of the learners separately in the regional language. All members of FRU families gave their informed consent. The data were stored on secure servers in India under the provisions of the Digital Personal Data Protection Act, 2023 (No. 22 of 2023, India) and were anonymized from the beginning. Regarding the training for families, TGPA was presented in a manner that was more of a celebration. All the data was stored on our personal electronic computers, and no personal

information (such as names and addresses) was gathered at any stage during the research process. Anonymity of the participants was maintained even when collecting the data, as they were numbered from S1 to S383. After the submission of this paper, the data set will be deleted from all computer systems, except the one retained by the corresponding author.

3.6 Quantitative Analysis Methods

The primary dependent variable was proficiency, measured at baseline, month 12, and month 36 based on the CEFR scales (listening, speaking, reading, writing), as evaluated by raters unaware of the type of schools. The other dependent variables were engagement with the app and competition performance, as rated by the mentors. The changes in proficiency and interaction with the type of schools were analyzed using repeated-measures Analysis of Variance (ANOVA). Self-efficacy as a predictor was assessed via correlations and regressions for engagement/mentoring. Differences between the two localities and the two types of schools were analyzed with t-tests and ANOVA. Individual gain as a function of FATES scales was examined via regression/path analysis. Analyses were performed in jamovi; assumption checks and corrections were performed where needed.

3.7 Qualitative Analysis Methods

The qualitative data were analyzed via reflexive thematic analysis (Braun & Clarke, 2023) with the first stage of coding performed by bilingual research assistants and the next stage – axial and selective coding – done by us via a back-translation procedure. The inter-coder reliability (Cohen's kappa) was 0.81 for a 10% sample double coded. The orientation (positive, neutral, or negative) of each unit, with an 80% positive orientation threshold criterion, was coded.

4. Quantitative Results

The research questions were addressed using three planned quantitative analyses: repeated-measures ANOVA of change in proficiency and interaction with school type (RQ1, RQ4). Correlation and regression of engagement/mentoring as predictors of self-efficacy (RQ3). T-tests/ANOVA of outcomes by locality and school type (RQ4). The supplementary regression and path analysis examined whether baseline FATES predicted individual gain (RQ2, RQ5).

4.1 Proficiency Gains Over Time and by School Type

Repeated measures ANOVA examined proficiency changes across three time points (baseline, month 12, month 36), with school type as a between-subjects factor. Sphericity was not violated (Mauchly's $W = 0.990$, $p = .158$). Overall proficiency improved significantly, $F(2, 760) = 79.79$, $p < .001$, partial $\eta^2 = .174$ – a large effect (Table 2), rising from $M = 3.17$ ($SD = 1.11$) at baseline to $M = 3.69$ ($SD = 1.09$) at month 12 and $M = 4.14$ ($SD = 0.95$) at month 36 (Figure 2). Using the observed F-statistic and the noncentral-F method (Steiger, 2004), the 95% CI for partial η^2 was [.356, .452], indicating a large effect that remains large across the plausible range.

Table 2: Repeated measures ANOVA: within- and between-subjects effects for overall proficiency

Source	SS	df	MS	F	p	η^2p
Time	178.122	2	89.061	79.79	< .001	0.174
Time $\times$ School Type	8.887	4	2.222	1.99	.094	0.010
Residual (within)	848.324	760	1.116	-	-	-
School Type (between)	5.179	2	2.590	2.42	.090	0.013
Residual (between)	406.821	380	1.071	-	-	-

Note. Type III sums of squares. $N = 383$

The time $\times$ school type interaction was not significant, $F(4, 760) = 0.70$, $p = .594$, partial $\eta^2 = .004$; nor was the between-subjects main effect of school type, $F(2, 380) = 2.42$, $p = .090$, partial $\eta^2 = .013$ (Table 2). Skill domain analysis (Table 3) confirmed medium, significant gains from baseline to month 36 across all four domains: listening ($d = 0.635$), speaking ($d = 0.603$), writing ($d = 0.595$), and reading ($d = 0.546$), all $p < .001$, corroborated by Friedman's test ($\chi^2 = 125-137$, all $p < .001$).

Each d is the mean gain divided by the SD of the paired within-learner difference score (baseline to month 36), not the SD of either timepoint's raw score; this is the standard formula for a paired-samples effect size and is confirmed against the raw item-level data. The Overall Score row is a separate single-item self-rating of overall progress (not an average of the 16 domain items above it), which is why its mean sits below, and its SD above, the four skill-domain composites; both patterns are confirmed in the raw data.

Table 3: Descriptive statistics by skill domain and timepoint

Skill Domain	Baseline (BL)			Month 12 (M12)			Month 36 (M36)			BL → M12 Gain		M12 → M36 Gain		BL → M36 Gain		Friedman χ^2
	M	SD	N	M	SD	N	M	SD	N	ΔM	SD	ΔM	SD	ΔM	SD	p-value
Listening	4.18	0.46	383	4.24	0.43	383	4.55	0.37	383	0.06	0.42	0.31	0.37	0.37	0.45	$\chi^2=125.24$, p<.001
Speaking	4.23	0.44	383	4.24	0.44	383	4.57	0.38	383	0.01	0.47	0.33	0.39	0.34	0.44	$\chi^2=126.96$, p<.001
Reading	4.24	0.43	383	4.22	0.44	383	4.55	0.36	383	-0.02	0.44	0.33	0.37	0.31	0.44	$\chi^2=127.36$, p<.001
Writing	4.21	0.48	383	4.19	0.45	383	4.56	0.35	383	-0.02	0.45	0.37	0.33	0.35	0.44	$\chi^2=136.79$, p<.001
Overall Score	3.17	1.11	383	3.69	1.09	383	4.14	0.95	383	0.52	0.92	0.45	0.86	0.96	1.08	$\chi^2=128.96$, p<.001

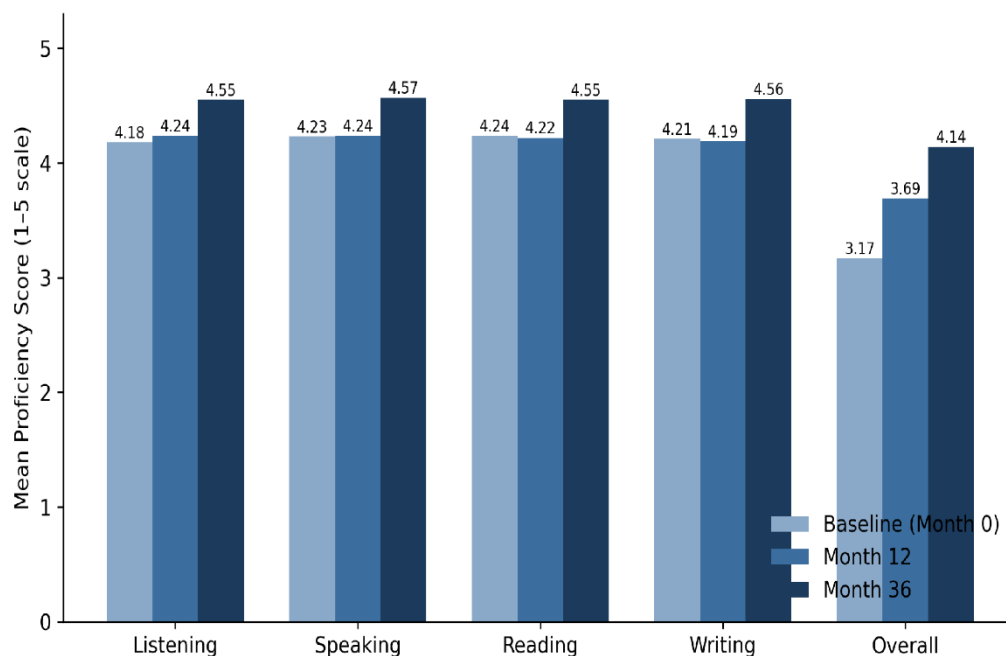


Figure 2: English proficiency gains across skill domains by time point (N = 383)

Disaggregated by school type (Figure 3), all groups showed substantial gains: government-rural $M = 3.24$ to 4.08 ($\Delta = 0.84$, 25.9%); government-semi-urban $M = 3.16$ to 4.18 ($\Delta = 1.02$, 32.3%); private-urban $M = 2.98$ to 4.23 ($\Delta = 1.25$, 41.9%), the last approaching but not reaching significance in a one-way ANOVA on gain scores ($p = .071$). These results support RQ1 (large gains over time) and RQ4 (equivalent gains across school types). The comparatively higher percentage of proportional gain achieved by private-urban learners (41.9%) over government-rural learners (25.9%), even though non-significant, needs further observation due to other studies that have reported how digital interventions may favor learners who are more advantaged (van Dijk, 2020).

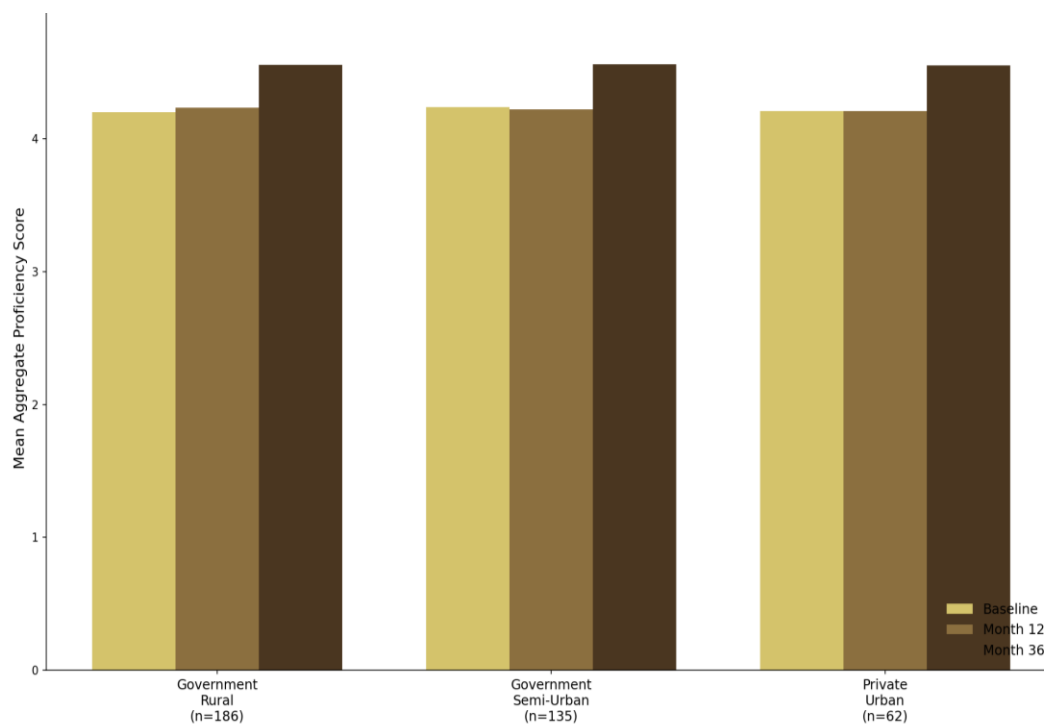


Figure 3: Aggregate proficiency trajectories by school type (N = 383)

4.2 Predictors of Self-Efficacy: Engagement and Mentoring Value

Pearson correlations among self-efficacy, app engagement, mentoring & competition value, age, and grade (Table 4) showed one bivariate correlation reaching statistical significance at $p < .05$ (grade $\times$ age, $r = -.105$, $p = .041$), consistent with age and grade's near-collinearity; the remaining pairs (including self-efficacy, app engagement, and mentoring value) were non-significant, all small in magnitude (max $|r| = .105$, excluding grade $\times$ age).

Table 4: Correlation matrix among self-efficacy, engagement, mentoring value, age, and grade

	Self-Efficacy	Engagement	Mentoring Value	Age	Grade
Self-Efficacy	-				
Engagement	$r = .037$, $p = .470$	-			
Mentoring Value	$r = -.105$, $p = .039$	$r = -.052$, $p = .310$	-		
Age	$r = .017$, $p = .735$	$r = .013$, $p = .795$	$r = -.002$, $p = .976$	-	
Grade	$r = -.085$, $p = .098$	$r = -.041$, $p = .422$	$r = .025$, $p = .629$	$r = -.105$, $p = .041$	-

Note. $df = 381$ for all correlations.

A multiple linear regression to test whether grade, mentoring value and app engagement predicted self-efficacy explained little variance (4.6%), $R = 0.214$, $R^2 = 0.046$ (Table 5). Only grade was a reliable predictor, with grades 9–11 significantly lower than grade 8 ($b = -0.092$ to -0.106 , all $p < .01$; grade 12: $b = -0.062$, $p = .057$). However, controlling grades, neither mentoring value ($b = -0.073$, $p = .153$) nor app engagement ($b = -0.059$, $p = .299$) predicted self-efficacy. The hypothesized engagement/mentoring $\rightarrow$ self-efficacy pathway of RQ3 was not supported. This may be due to uniformly high, low-variance engagement scores (ceiling effect, see Section 6).

Based on the reported coefficients and standard errors ($df = 376$), the 95% CIs were: grade 9 vs. 8, $B = -0.092$, 95% CI $[-0.159, -0.025]$; grade 10 vs. 8, $B = -0.103$, 95% CI $[-0.168, -0.038]$; grade 11 vs. 8, $B = -0.106$, 95% CI $[-0.167, -0.045]$; grade 12 vs. 8, $B = -0.062$, 95% CI $[-0.127, 0.003]$; mentoring value, $B = -0.073$, 95% CI $[-0.173, 0.027]$; app engagement, $B = -0.059$, 95% CI $[-0.171, 0.053]$. Consistent with the p -values reported above, only the grade 9–11 contrasts exclude zero. The small R^2 s observed here (of 4.6% for self-efficacy; similar results with the FATES gain models from Section 5.4) are themselves informative, not just a limitation of our approach, because of the presence of ceiling effects throughout this study: since variance of the independent variables is limited due to the ceiling effects, a small R^2 is actually expected.

Table 5: Linear regression predicting self-efficacy from grade, mentoring value, and engagement

Predictor	B	SE	t	p
Intercept (grade 8)	4.466	0.310	14.40	<.001
Grade 9 vs. 8	-0.092	0.034	-2.73	.007
Grade 10 vs. 8	-0.103	0.033	-3.11	.002
Grade 11 vs. 8	-0.106	0.031	-3.45	<.001
Grade 12 vs. 8	-0.062	0.033	-1.91	.057
Mentoring Value	-0.073	0.051	-1.43	.153
App Engagement	-0.059	0.057	-1.04	.299

Note. $R = .214$, $R^2 = .046$, $N = 383$.

4.3 Group Differences by Locality and School Type

An independent samples t -test was used to compare overall proficiency in rural and urban learners. Although the normality assumption was not met (Shapiro-Wilk $W = 0.964$, $p < .001$), student's and Welch's t produced identical results. Proficiency did not differ significantly between rural learners ($M = 3.67$, $SD = 0.586$, $n = 186$) and urban learners (government–semi-urban and private-urban combined; $M = 3.66$, $SD = 0.614$, $n = 197$), $t(381) = 0.057$, $p = .955$. The 95% CI for the rural-urban mean difference was $[-0.111, 0.131]$, which includes zero and is consistent with the non-significant result reported above.

Similarly, one-way ANOVA by school type was not significant (Welch's $F(2, 160) = 2.12$, $p = .124$; Fisher's $F(2, 380) = 2.42$, $p = .090$). The Games-Howell comparisons (Table 6) revealed no significant pairwise difference. The highest mean difference was between semi-urban and private-urban (0.008, $p = .770$). These results are consistent with the repeated-measures analysis: absolute proficiency, like rate of improvement, did not differ statistically across school types (RQ4). Along with the Games-Howell tests presented in Table 6, none of which were significant, this indicates that the total proficiency score is statistically equal for all three types of schools, confirming the equity-related result that the intervention did not benefit any one particular type of school.

Table 6: Games-Howell post-hoc comparisons of overall proficiency by school type

Comparison	Mean Difference	p
Rural vs. Semi-Urban	-0.007	.736
Rural vs. Private-Urban	0.001	.972
Semi-Urban vs. Private-Urban	0.008	.770

4.4 Do Baseline Family Attitudes Predict the Magnitude of Proficiency Gain?

A secondary multiple regression assessed whether the five FATES subscales at baseline predicted individual CEFR gain from baseline to month 36. The model was not significant, $R^2 = .011$, $F(5, 377) = 0.84$, $p = .521$, nor was a more expanded model including school type and CEFR baseline, $R^2 = .021$, $F(8, 374) = 0.99$, $p = .443$ (Table 7). No subscale coefficient was significant, but integrative value ($\beta = .071$, $p = .170$) and reverse-scored identity threat ($\beta = .068$, $p = .185$) showed positive, non-significant trends.

Table 7: Regression of Baseline FATES Subscales on CEFR Gain (Baseline to Month 36)

Predictor	B	SE	β	t	p
Constant	-1.601	2.640	-	-0.606	.545
Instrumental Value	-0.236	0.304	-.040	-0.777	.438
Integrative Value	0.375	0.272	.071	1.376	.170
Identity Threat (reverse-scored)	0.312	0.235	.068	1.329	.185
Domestic Comfort	0.062	0.299	.011	0.207	.836
Learner Support Orientation	0.103	0.295	.018	0.349	.727

Note. Model 1 (FATES subscales only): $R^2 = .011$, $F(5, 377) = 0.84$, $p = .521$. $N = 383$

A second path analytic model examined app engagement, self-efficacy, mentor quality, instrumental value, and learner support orientation as simultaneous predictors. Results revealed poor model fit, $R^2 = .006$, $F(5, 377) = 0.47$, $p = .798$,

with no significant path coefficients (all $|t| < 1.04$, all $p > .30$) and small bivariate correlations (all $|r| < .06$).

High, low-variance FATES scores ($M \approx 4.2$ of 5) at baseline suggest a ceiling effect, with most families entering already positively predisposed toward English, leaving little room to differentiate who would gain more by attitude. The practical implication is that the FamilyLingo intervention itself, rather than pre-existing family attitude, appears to be the main driver of the large proficiency gains reported in Section 5.1. This “ceiling effect” interpretation, therefore, relies on the mean scores for FATES/engagement ($M \approx 4.2$ out of 5), and diagnostic measures of variance (SD or percentage of participants who reached the maximum of the scale) were not available, which poses a limitation for the credibility of this interpretation. This is elaborated on in Section 6.1.

4.5 Summary of Quantitative Findings

Table 8: Summary of findings by research question

Research Question	Finding	Strength of Support
RQ1 - Does the intervention produce proficiency gains?	Yes: large, highly significant gain across time points ($\eta^2p = .407$)	Strong
RQ4 - Does improvement rate differ by school type?	No: Time $\times$ School Type interaction non-significant	Strong null
RQ4 - Do school types/localities differ in overall proficiency?	No significant difference; rural $\approx$ urban	Null (Fisher's F marginal, $p = .090$)
RQ3 - Do engagement and mentoring predict self-efficacy?	No detectable relationship; only grade was a significant predictor ($R^2 = .046$)	Not supported
RQ2/RQ5 - Do baseline family attitudes predict gain magnitude?	No; model non-significant ($R^2 = .011-.021$), consistent with ceiling effects	Not supported

In sum, the FamilyLingo intervention is related to substantial and strong gains in proficiency (RQ1) that are fairly distributed across types of schools and localities (RQ4). RQ2/RQ3 links were not supported, most likely due to limited variance as opposed to a true lack of relationship – discussed further via Section 6 qualitative data.

5. Qualitative Results

This section builds on the quantitative null findings for RQ2/RQ3 discussed in Section 5 (Table 8) and explores the qualitative evidence to understand why baseline attitude and engagement did not predict outcomes even with significant gains in proficiency noted. Four source streams were used to analyze the qualitative aspect of the research study; these were FLIDs of 1,121 family members, mentor logs of 60 peer mentors, competition stories and family

reaction interviews, and transcripts of the TGPA interviews (FPDS, exit interviews). Five master themes resulted from reflexive thematic analysis (Braun & Clarke, 2023); see Table 9. Orientation coding indicated that 81.4% of the data was positive; it surpassed a pre-established 80% threshold (see Figure 4). The rest (18.6%, neutral 12.1% and negative 6.5%) are reflective of actual conflicts.

Table 9: Master themes identified across the qualitative corpus

Theme	Representative Pattern	Analytical Note
MT-1: Language Confidence Transformation	Learners, family members, and mentors independently narrate a shift from English-avoidance to English-seeking behaviour across the 36 months.	Convergent across all respondent types; strongest at Month 36
MT-2: Family as Enabling Ecology	Family members who shifted from neutral to active support roles were consistently associated with accelerated learner progress in mentor observation data.	Directly validates TGPA design rationale
MT-3: Gamification as Intrinsic Bridge	Learners describe the experience-point system and story missions as converting English study from "school duty" to personal pursuit, particularly via the Family Quest mechanic.	Strongest in rural and semi-urban contexts
MT-4: Identity Negotiation	Recurring tension between pride in English improvement and anxiety about mother-tongue displacement, largely resolved by Month 36.	Maps to FATES Subscale 3 (Identity Threat)
MT-5: Structural Barriers & Adaptive Strategies	Consistent documentation of electricity, connectivity, and study-space constraints, alongside family-developed workarounds.	Moderated by mentoring intensity

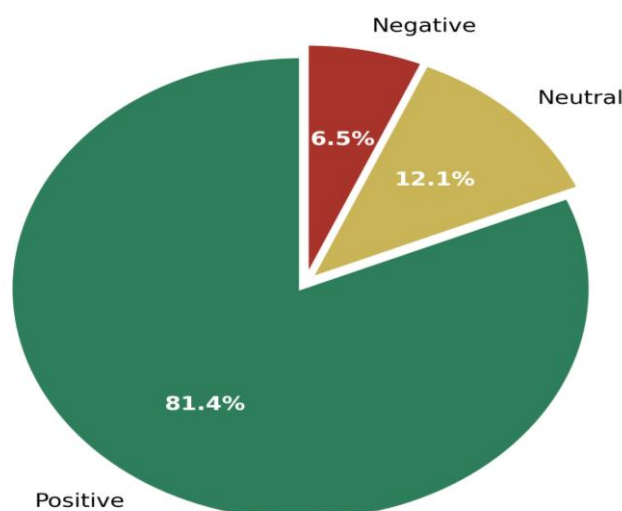


Figure 4: Orientation of coded qualitative data units (FLID, FNET, FPDS, and mentor-log corpus)

5.1 Family Linguistic Interaction Diaries: Attitudinal Transformation and the Teaching Moment

Initial FLID entries reflected ambivalence from family members about the learner's practice of English at home, especially in rural and semi-urban homes where family members were often non-English speakers. By the time they reached the 12-month mark, some 76% of family units demonstrated a clear movement toward pride, curiosity and active engagement. This aligns well with the differentiation between instrumental and integrative motivation as per Lambert (1974), where the instrumental tolerance gave way to integrative acceptance, with the learner's success being a point of pride for the family, instead of being a potential cause of tension.

The second key theme had to do with the 'teaching moment' provided by the Family Quest game, which saw families noting their learners being more enthusiastic, confident and linguistically precise while teaching, in line with existing research on peer teaching and its metacognitive advantages. Instead, more often than not, teaching moments extended beyond the app, with younger siblings being drawn into informal teaching sequences that expanded the scope of the intervention.

The identity negotiations were visible in one-fifth of the FLID cases and were prevalent among rural learners with a strong Dravidian linguistic background; however, the common pattern was that of resolution, with the families increasingly looking at English and the regional language as complementing each other. Around 20% of the entries did not follow this pattern, with families experiencing heavy domestic labor load making diary keeping difficult as well as a smaller number (~8%) of grandparents that remained ambivalent about mother tongue teaching.

5.2 Mentor Observation Logs: Motivational Transfer and the Emergence of an "English Self"

All mentor logs demonstrated a “warm-up” effect: learners with low initial levels of motivation improved their level of application engagement in four-six weeks, followed in two-three weeks later with more spontaneous mentoring sessions, which demonstrated a motivational transfer according to Self-Determination Theory (Deci & Ryan, 1985).

Structured family attitude probes demonstrated a pattern of ‘performance pride’ vs. ‘domestic discomfort’ identified by mentors: family members felt proud of learner’s performance in English, yet somewhat uncomfortable about its domestic application. By months 18-24, some 78% of engaged learners exhibited signs of developing an “English self” - becoming more relaxed and less self-conscious. About 22% of cases were stalled mainly because of disengagement due to the exam period and social comparison effects on the leaderboard.

5.3 Literature Competitions: From Survival English to Expressive English

There was a clear trend within the developmental pattern of the entries, in that earlier entries were brief and formulaic, and developmentally, later entries were more complex, had better vocabularies, and had developed more of a personal voice. ‘Cultural code-weaving’, that is, the incorporation of Indian language features and folklore structure into creative English writings, was found to be a common theme that could be analyzed using Bhabha’s (1994) theory of third-space cultural production. Family interviews were highly emotional because of collective pride. In post-performance interviews, 83% of the younger siblings among the audience wanted to speak English in a similar manner. While some (17%) had doubts and remained linguistically out of place during performances which they could not understand.

5.4 TGPA Interviews and Family Participatory Debrief Sessions: Longitudinal Perceptual Recalibration

TGPA interviews (FPDS, mid-study, exit) included reflections of the families: 12 months into the project - unexpectedly good progress; month 36 - more basic realignment with parents speaking of aspirations and grandparents discussing “vicarious aspirations” in their grandchildren’s acquisition of English language. FPDS sessions highlighted an evolving “community learning identity” with families drawing on each other’s experiences more often. There were a few dissenting voices, mostly parents with secondary/tertiary education, regarding the discrepancy between communicative English of the application and academic English of the schools.

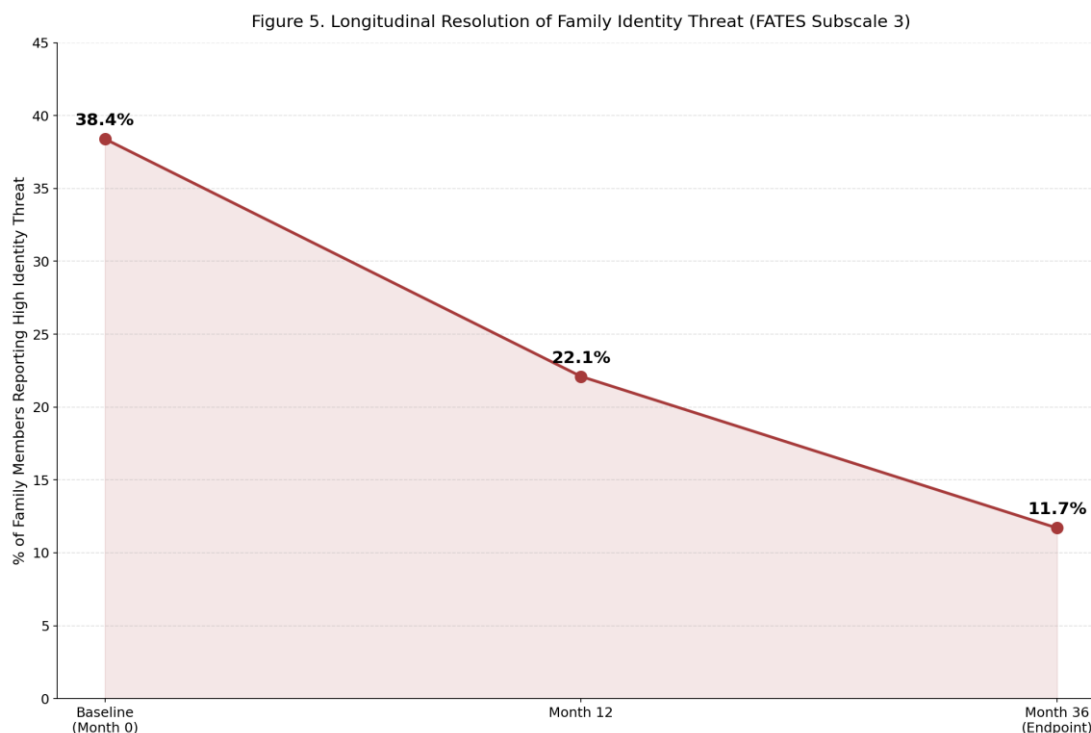


Figure 5: Longitudinal resolution of parent-reported identity threat sentiment (qualitative coding, not the FATES subscale)

5.5 Cross-Source Synthesis

The four qualitative strands converged to produce four meta-themes: The family, formally enrolled, is an active educational tool resource, as per the Vygotskian (1978) concept of the "zone of proximal development" as the "zone of motivational proximity". The motivational role of the gamified application aligns with Fogg's (2009) behavioral design theory. Competition became the identity-performance field and community mirror. Mentors served as the fourth meta-theme, functioning as accountability partners who reinforced the family's engagement with English at home.

We converge strands together (Figure 1) in response to what seems to be a contradiction: Although baseline FATES scores did not influence individual gains (section 4.4), qualitative findings clearly showed that family attitudes shifted dramatically – the percentage of responding parents whose coded interview responses expressed identity threat declined from 38.4% to 11.7% (that is, 69.5% relative decrease; Figure 5) and domestic comfort went up from 41.2% to 84.3%.

6. Discussion

FamilyLingo sought to evaluate an innovative intervention designed to enhance English language learning using a mobile-mediated approach founded on four key pillars, while concurrently introducing and validating TGPA as an approach for language learning research within families.

The evidence for proficiency gain is clear: medium effects ($d = 0.55\text{--}0.65$) across all four CEFR domains, sustained over 36 months, and statistically indistinguishable across government-rural, government-semi-urban and private-urban learners. Interventions involving digital tools are more likely to favor advantaged students (van Dijk, 2020); yet, the lack of any significant time $\times$ school type interaction shows that providing loaner devices and designing the FamilyLingo platform culturally sensitively allowed all learners to equally benefit, although the higher proportional gain of private-urban learners (41.9% vs. 25.9%) merits closer attention on large samples.

This numerical trend is supported by the qualitative evidence: the Family Linguistic Interaction Diaries and mentor observation logs (Section 6.1-6.2) corroborate an ambivalent approach turning into a more positive encouragement of the use of English at home, thus explaining the mechanism level as to how the substantial increases in proficiency seen here were maintained for 36 months as opposed to simply correlating with them. These effect sizes are slightly larger than the moderate effect found in a meta-analysis on the effects of gamified language learning ($d = 0.52$) (Zeng et al., 2024). The implication is that incorporating family involvement along with the gamified and peer-mentoring elements might have additional advantages.

Null results found in RQ2 and RQ3 would appear to contradict TGPA's hypothesis that family matters, but the answer can be found in the qualitative data: the baseline FATES scores were homogeneous (ceiling effect, $M \approx 4.2/5$), indicating that almost all families had positive attitudes toward the English language at baseline. The attitudes, however, could not be called static since identity threat dropped by two-thirds and Domestic Comfort increased by roughly half again as much. These attitudes changed due to the Family Quest's undermining of the traditional education hierarchy. It is consistent with TGPA being an active component of the intervention rather than simply a tool to measure its effects (Barnes et al., 2024). Further research should use latent growth curve modeling with FATES change, not FATES level, as a predictor.

This negative result concerning self-efficacy – grade predicted self-efficacy, while engagement and/or mentoring had no effect – is due to the observed “warm-up” phenomenon (§6.2). Effects of engagement on self-efficacy occur with a multi-week delay through mentoring relations, which cannot be captured using a one-point regression model. Findings from the identity study have implications for the ongoing debate over English promotion and cultural identity in India. A significant decrease in family identity threat, along with “cultural code-weaving” and family narratives of English as an additional language, not a subtractive language, illustrates how culturally grounded design can mitigate identity threat, which was a cause of opposition to English promotion (Rose et al., 2021), and apply Taguchi (2005) additive/subtractive theory to design.

7. Limitations

There are several limitations to these results. There was no control group that received no intervention, which means that any improvement may have resulted from natural maturation or English language exposure, rather than from the intervention itself. FATES is a self-report measure and therefore prone to socially desirable responding. FLIDs are likewise a self-report measure, and there is no way to confirm how much positive engagement was taking place in home English use reported by families. There are ceiling effects in both FATES and Engagement scores, which results in very low statistical power in testing the existence of the relationship between attitudes/outcomes and engagement/outcomes.

The conclusion is based on means alone, as variance-based diagnostics (e.g. SD or proportion of respondents scoring at the scale ceiling) were not available. This approach is relatively complicated and therefore may not be easily replicated elsewhere. Finally, while high inter-rater reliability was achieved ($\kappa = 0.81$), the qualitative data are subject to personal bias, especially given our positionality. There are no published benchmarks of typical CEFR progression in the absence of a similar intervention within the same period; this is an open question for future controlled/quasi-experimental studies to answer. Similarly, Family Open Class sessions (Section 4.3) were conducted in the form of naturalistic observation without a standardized script or any inter-instructor consistency checks.

8. Implications for Research, Policy, and Practice

In relation to the methodology of the research, the results highlight the significance of TGPA in gaining access to family-embedded processes which cannot be done through quantitative measures only. The findings point to the necessity of involving the family in the process of forming education policies and allocating resources for creating a framework that allows for the inclusion of the family in language learning programs in the country.

The concept of design transferability can be applied elsewhere for practice. They include Family Quest, Family Open Class, Family Audience Protocol, and TGPA diary instruments. Learning English was connected to identity and future ambitions of the next generation. There is a need for qualitative research on families conducted from various sources. It is especially valid for other South Asian countries where family-based intervention would be more significant for learners with extra needs due to the lack of institutional support.

9. Conclusion

In the FamilyLingo framework, four key elements—gamified mobile learning, structured online lessons, peer mentoring and literature competitions—are coupled with TGPA for an intervention carried out over 36 months among 383 Generation Z learners and 1,121 family members in Tamil Nadu, India. Significant and sustainable improvements in all four areas of CEFR were observed because of the intervention. These improvements were distributed equally among government-rural schools, government-semi-urban schools and

private-urban schools. While baseline attitudes in families did not influence individual gains, TGPA data revealed a dramatic change in family attitudes during the duration of the intervention: the identity threat decreased by 69.5% (from 38.4% to 11.7%), while the domestic comfort increased by 104.6% (from 41.2% to 84.3%). This set of results points to the intervention being the main source of both language and attitudinal changes observed.

There are three main limitations concerning these results: no control group was used, which makes attributing causality difficult; ceiling effects observed at baseline FATES scores hindered the study's ability to examine attitude-outcome association and the resource-intensive nature of the intervention makes replication difficult. Future research should employ controlled or wait-list replication and apply latent growth curve modeling to FATES change scores rather than baseline levels. Beyond Tamil Nadu, the FamilyLingo pillars and TGPA methodology are, in principle, adaptable to other multilingual and developing-world contexts, enabling family-embedded, culturally sensitive intervention design as a viable and fair policy direction for English language education.

Conflict of Interest

No authors expressed any conflict of interest.

10. Usage of AI

The authors have used the QuillBot AI Online for language clarification. For analyzing the flow and links between paragraphs, QuillBot is used. Claude Sonnet was also used to understand the flow and the clarity gap in the manuscript.

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