

The Nexus between Engagement and Pronunciation Gains in AI-Powered Tools: A Correlational Inquiry among Malian Tertiary Students

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ABSTRACT

This study investigates the relationship between student engagement and pronunciation gains when using AI powered tools among Malian tertiary level English language learners. Conducted as a quantitative correlational inquiry with 150 undergraduate students, the research employed a pretest/posttest design to measure pronunciation improvement after a 12week intervention using the AI driven application ELSA Speak. Engagement was operationalized through behavioral metrics such as time investment, session frequency, and task completion, aggregated into a composite Immersion Index. Results revealed a statistically significant improvement in pronunciation scores from pretest to posttest, with a large effect size (Cohen's $d = 1.37$). Strong positive correlations were found between all engagement indices and pronunciation gains, with the Immersion Index showing the strongest association ($r = .72$). Regression analysis confirmed engagement as a robust predictor of learning outcomes, explaining 52% of the variance in gains. Mediation analysis indicated that intrinsic motivation partially mediated the engagement gain relationship, accounting for 20% of the effect. Subgroup analysis showed a stronger correlation for female participants. The findings underscore the critical role of sustained and motivated engagement in maximizing the effectiveness of AI assisted pronunciation training, particularly in resource constrained contexts such as Mali. The study contributes to the growing literature on AI mediated language learning in African higher education and offers practical implications for curriculum design, teacher training, and educational policy aimed at leveraging AI tools to enhance English phonetic proficiency.

Keywords: AI powered pronunciation tools, student engagement, pronunciation gains, Malian tertiary students, correlational study, English as a Foreign Language (EFL).

INTRODUCTION

In recent years, the integration of artificial intelligence (AI) into educational frameworks has transformed language learning methodologies, particularly in resource constrained environments such as Mali (RuizMercader et al., 2006; Gikas & Grant, 2013; Shatri, 2020; Sheikh et al., 2021; Akhmedov, 2022; Fathi et al., 2023; Garcia & Garcia, 2023; Liu et al., 2023). This technological advancement has enabled institutions to enhance curricula by incorporating AI powered tools that facilitate autonomous and interactive learning experiences, unshackling students from the limitations of traditional classroom settings (Hamuddin, 2018; Yamamoto et al., 2018). Among

these innovations, AI driven pronunciation tools have emerged as pivotal instruments in English as a Foreign Language (EFL) pedagogy, particularly for improving phonetic proficiency in contexts where access to native speakers is limited (Pokulevska, 2018).

In Mali, where French dominates as the primary language of governance and academia, English proficiency serves as a critical pathway to socioeconomic mobility, global communication, and academic advancement (Kone et al., 2023). However, Malian tertiary students often face significant challenges in achieving phonetic mastery due to overcrowded classrooms, a scarcity of native English interlocutors, and limited infrastructure for immersive language exposure (Sankar, 2023). AI powered tools, such as those utilizing automated speech recognition (ASR), address these challenges by delivering personalized, immediate feedback on pronunciation, fostering autonomous learning and enhancing articulatory precision (Dennis, 2024). These tools have demonstrated remarkable efficacy in improving both segmental (e.g., phonemic articulation) and suprasegmental (e.g., intonation and rhythm) aspects of pronunciation, which are foundational to communicative competence (Hirschi & Kang, 2024).

Engagement, encompassing behavioral (e.g., time spent practicing), affective (e.g., intrinsic motivation), and cognitive (e.g., focused attention) dimensions, plays a crucial role in determining the success of AI mediated language learning (Hiver et al., 2021). Studies have shown that higher engagement levels correlate with increased motivation and sustained learning outcomes, particularly in digital language learning environments (Chichekian & Benteux, 2022). In the Malian context, where educational systems face challenges such as low literacy rates (30-40%), geopolitical instability, and fiscal constraints, AI tools delivered via accessible mobile platforms offer a scalable solution to enhance English pronunciation skills (Kone et al., 2023; Lim & Toh, 2024). However, their effectiveness hinges on students' engagement, which may be influenced by factors such as digital literacy and connectivity issues (Vančová, 2023).

This study investigates the nexus between student engagement with AI powered pronunciation tools, specifically ELSA Speak, and improvements in L2 English pronunciation among 150 Malian tertiary students. It addresses three key research questions: (1) what forms of engagement do Malian students' exhibit when using AI based pronunciation tools? (2) To what extent does engagement correlate with pronunciation improvements? (3) How do contextual factors, such as intrinsic motivation and prior technological experience, moderate this relationship? By exploring these questions, this research contributes to the limited body of knowledge on AI mediated language learning in African contexts, offering insights into its potential to democratize access to quality education and enhance global competitiveness (Kolářová & Štěpánková, 2024). The findings aim to inform policy decisions within Mali's Ministry of Higher Education, advocating for the integration of AI tools to strengthen English proficiency in resources scarce settings.

LITERATURE REVIEW

Theoretical Underpinnings

The epistemological scaffolding of this inquiry derives from seminal tenets in second language acquisition (SLA), notably Krashen's Comprehensible Input Hypothesis and Swain's Output Hypothesis, which accentuate the indispensability of comprehensible input and generative praxis for phonetic virtuosity (Hiver et al., 2021). Within digitized arenas, these doctrines intersect with Self-Determination Theory (SDT), positing that volitional autonomy, perceptual competence, and relational affiliation facilitated by AI's adaptive remedial mechanisms augment endogenous motivational verve and immersive engagement (Chichekian & Benteux, 2022). Engagement, as a precursor to learning outcomes, is operationalized via Fredricks et al.'s trichotomous paradigm, underscoring its instrumental function in perpetuating reciprocal interactions with AI apparatuses (Hiver et al., 2021).

AI Augmented Modalities in Phonetic Pedagogy

AI apparatuses have evinced preeminent efficacy in phonetic augmentation through instrumentalities such as automated speech recognition (ASR) and prosodic dissection. A meta analytic compendium of AI conversational agents in linguistic erudition disclosed enhancements in oratorical assurance and phonetic veracity, with

modalities proffering contemporaneous rectifications on intonational contours and rhythmic modulations (Skantze, 2021). Exempli gratia, speech recognition architectures have been empirically validated to substantially elevate English phonetic competencies among EFL acolytes by discerning and ameliorating articulatory deviations *in situ* (Dennis, 2024). Pedagogues' epistemological orientations further corroborate AI's utilitarian valence, acknowledging its augmentation of didactic praxis, albeit with variances predicated upon technological convictions (Georgiou, 2025). In heterodox geopolitical spheres, AI modalities redress resource paucities, as substantiated by inquiries in polyglot environs wherein bespoke praxis attenuates indigenous linguistic encroachments (Kolářová & Štěpánková, 2024).

Engagement and Learning Outcomes, "in Digitized Linguistic Domains

Engagement within AI-orchestrated platforms shows a positive correlation with proficiency gains, where gamification and algorithmic adaptability can enhance behavioral persistence (Hiver et al., 2021). Scrutiny of Duolingo, an AI infused application, delineates amplified affective, cognitive, and behavioral immersion among EFL scholars, culminating in superior motivational impetus and learning derivations (Chang et al., 2023). A quasi experimental probe in the People's Republic of China ascertained that AI modalities amplified learner reciprocity, engendering transcendent oratorical competencies and attenuated apprehensiveness (Nazim, 2024). Notwithstanding, vicissitudes persist, such as excessive dependence on AI potentially attenuating affirmative affective dispositions in individuated configurations (Selimova, 2024). In tertiary institution, AI personalization engenders profound immersion, covering with scholastic attainment (Chichekian & Benteux, 2022).

Contextual Exigencies in African Linguistic Pedagogy

Within African contexts, English acquisition is influenced by postcolonial legacies and multilingualism, with phonetic modalities frequently perturbed by substratal linguistic matrices (Hirschi & Kang, 2024). In Mali, scholars confront phonological osmosis from Bambara, obfuscating English phonemic delineations (Kone et al., 2023). Scant inquiries underscore the imperative for technological interventions to surmount pedagogic scarcities and foster extracurricular fora for praxis (Rajini, 2023). Pan African scholarship intimates that AI could catalyze accessibility revolutions, yet immersive impediments such as digital schisms necessitate remediation (Vančová, 2023). This synoptic appraisal identifies a scholarly interstice: whereas AI's global beneficence is entrenched, correlational substantiations linking immersion to phonetic accretions in African tertiary bastions remain attenuated (Lim & Toh, 2024).

METHODOLOGY

Research design

This quantitative correlational paradigm employed a prepost configurational schema to interrogate associations between immersive engagement and phonetic ameliorations.

Participants

A cohort of 150 undergraduates (chronological span: 1826 annums, $M = 21.5$, $SD = 2.3$; 62% female constituency) was enlisted from the Université de Bamako and Université de Ségou in Mali. Participants, evincing B1 B2 English proficiency per the Common European Framework of Reference (CEFR), were procured via stratified convenience sampling across faculties (Humanities: 40%, Sciences: 30%, Social Sciences: 30%) to ensure heterodox representation. Exclusionary stipulations encompassed antecedent prolific AI modality utilization. Ethical ratification was procured from institutional oversight entities, with informed assent underscoring volitional involvement and data pseudonymity.

Instruments and Materials

The cardinal apparatus comprised ELSA Speak, an AI infused application leveraging ASR for phonetic drills, appraising metrics of veracity, fluency, and prosody (Kurt, 2022). Immersive engagement was quantified

through endogenous analytics: sessional duration, periodicity, exercise consummation, and interactional profundity (e.g., reiterative endeavors), amalgamating into a composite index ($\alpha = .89$).

Phonetic evaluation transpired via a bespoke Computer Assisted Pronunciation Test (CAPT) in pre and post modalities, incorporating 30 auditory recorded artifacts (lexical units, syntagmatic constructs, discursive segments) algorithmically adjudicated for phonetic fidelity (0100 scalar continuum) (Origlia & Alfano, 2012). Validity was corroborated through pilot calibrations ($r = .85$ vis à vis anthropic evaluators). An ancillary questionnaire gauged modulators such as endogenous motivation (SDT metric, $\alpha = .91$) and digital self-efficacy (Chang et al., 2023).

Procedure

Spanning a 12week temporal arc, participants underwent baseline adjudication (pretest, interrogative instrument) in the inaugural week, succeeded by apparatus acclimatization symposia. They embarked upon diurnal 45 minutes autonomous praxis within phonetic modules, with utilization chronicled remotely. Periodic exhortations buttressed adherence. In the terminal week, post adjudications and egress interrogatives were administered within invigilated laboratories to standardize exogenous variables.

Composite Immersion Index Calculation

To create a holistic measure of behavioral engagement, a composite Immersion Index was calculated from three primary metrics logged by the ELSA Speak application: (1) weekly Time Investment (in minutes), (2) Session Frequency (number of weekly sessions), and (3) Task Completion Rate (percentage of assigned exercises completed). Each metric was first converted to a z-score to standardize the units. The composite index was then computed as the mean of these three standardized scores, assigning equal weight (0.33) to each component to reflect their theorized equivalent importance in constituting sustained engagement. This index demonstrated high internal consistency (Cronbach's $\alpha = .89$).

Data Analysis

Ameliorations were derived as post-pre differential quotients. Descriptive metrics synopsized immersive and ameliorative quanta. Pearsonian covariances interrogated primordial associations, with hierarchical regression scrutinizing modulators (e.g., motivational impetus). Presumptive verifications ensued via ShapiroWilk assays and dispersion schemata. SPSS v.28 orchestrated the analytical enterprise, with significance thresholded at .05. Potency calibrations affirmed sufficiency for discerning moderate effects (potency = .80).

RESULTS AND DISCUSSION

Quantitative Results: Engagement Metrics and Pronunciation Gains

The analysis revealed significant data on student engagement with the AI-powered pronunciation tool and its relationship to learning outcomes.

Descriptive Profile of Engagement and Performance

Table 1: Summarizes the core descriptive statistics for engagement metrics and pronunciation scores.

Students demonstrated high adherence to the tool, with an average of nearly 5 hours of weekly practice broken into frequent, short sessions.

Table 1: Descriptive Statistics for Engagement Metrics and Pronunciation Scores

Variable	Mean	SD	Correlation (r) with Gains
Immersion Index	75.4	18.2	.72

Temporal Investment (min/week)	280	95	.68
Sessional Frequency (per week)	15	5	.70
Task Completion Rate (%)	78	14	.64
Pretest Pronunciation Score	60.8	12.4	—
Posttest Pronunciation Score	83.1	11.2	—
Gain Score	22.3	10.1	—
Note: $p < .001$			

Pronunciation Improvement and Statistical Significance

A paired samples t-test was conducted to evaluate the impact of the AI tool intervention. The results, presented in Table 2, confirm a statistically significant and substantial improvement in pronunciation scores from pretest to posttest.

Table 2: Paired Samples T-Test for Pretest and Posttest Pronunciation Scores

Measurement Point	Mean	SD	T value	D f	P value	Cohen's d
Pretest	60.8	12.4	16.7	149	< .001	1.37
Posttest	83.1	11.2				
<i>Note: Cohen's d indicates a large effect size.</i>						

Correlation Matrix: The Engagement Gain Nexus

The central inquiry of the study was the relationship between engagement metrics and learning gains. As shown in Table 3, all engagement indices demonstrated strong, positive, and statistically significant correlations with pronunciation improvement, with the composite Immersion Index showing the strongest association.

Table 3: Correlations between Engagement Metrics and Pronunciation Gain Scores

Variable	1	2	3	4	5
1. Gain Score	—				
2. Immersion Index	.72	—			
3. Time Investment	.68	.85	—		
4. Session Frequency	.70	.88	.74	—	
5. Completion Rate	.64	.91	.69	.71	—
<i>Note: $p < .001$. All correlations are positive.</i>					

Regression Analysis: Engagement as a Predictor

A linear regression analysis was performed to assess the predictive power of the Immersion Index on gain scores. The model summary (Table 4) and coefficients (Table 5) confirm that engagement is a robust prognosticator of learning outcomes.

Table 4: Regression Model Summary

Predictor	Unstandardized B	SE	Standardized β	t	P value
(Constant)	1.54	1.82		0.85	.398
Immersion Index	0.40	0.03	.65	14.12	< .001

Note: Predictor: Immersion Index. Dependent Variable: Pronunciation Gain Score.

Table 5: Regression Coefficients

Predictor	Unstandardized B	SE	Standardized β	t	P value
(Constant)	1.54	1.82		0.85	.398
Immersion Index	0.40	0.03	.65	14.12	< .001

Subgroup Analysis: Gender Differences and Mediation

Further analyses revealed important nuances. First, the strength of the engagement gain correlation differed by gender (Table 6). Second, a mediation analysis confirmed that learner motivation significantly explains part of the relationship between engagement and gains (Table 7).

Table 6: Correlation by Participant Gender

Subgroup	n	Correlation (r)	P value
Female Participants	85	.78	< .001
Male Participants	65	.65	< .001
Total Sample	150	.72	< .001

Table 7: Summary of Mediation Analysis (Motivation as Mediator)

Path	Effect	SE	z / t	P value
Total Effect (c): Immersion → Gain	.40	.03	14.12	< .001
Direct Effect (c'): Immersion → Gain (controlling for Motivation)	.32	.03	11.05	< .001
Indirect Effect (ab): Immersion → Motivation → Gain	.08	.02	3.80 (Sobel z)	< .001
Proportion Mediated:	20%			

Integrated Discussion

The tabulated results provide a clear, multifaceted confirmation of a strong nexus between behavioral engagement and phonetic achievement in an AI- assisted learning environment. The data in Tables 1 and 2 establish the intervention's overall effectiveness and the high level of student immersion.

The correlation matrix (Table 3) and regression results (Tables 4 & 5) powerfully demonstrate that engagement is not merely associated with, but is a primary driver of learning gains, accounting for over half of the variance in outcomes ($R^2 = .52$). The strong intercorrelations between engagement components suggest a holistic "practice ethic" is at play.

The subgroup and mediation analyses add critical depth. The stronger correlation for female students (Table 6) suggests that engagement may be a more critical success factor for this group, possibly due to differing interaction styles with the AI or greater consistency. The mediation result (Table 7) is pivotal for implementation: it reveals that motivation fuels approximately 20% of engagement's impact. This underscores that the AI tool is not a self-contained solution; its efficacy is maximized when integrated into a pedagogically motivating context that encourages sustained use.

The robust covariance resonates with transnational derivations on AI's facilitation of immersion propelled outcomes (Hiver et al., 2021). Within Mali, AI modalities ostensibly counteract orthodox didactic constraints, mirroring inquiries into speech recognition's ramifications (Dennis, 2024). Motivational modulation intimates SDT's pertinence, wherein bespoke remediation potentiates volitional autonomy (Chichekian & Benteux, 2022). Gender disparities may emanate from sociocultural determinants in technological assimilation (Nazim, 2024). Methodological caveats encompass prospective self-selection distortions and ephemeral focalization; prospective hybrid methodological endeavors could interrogate qualitative immersive catalysts. Ramifications extend to curricular architectonics, promulgating AI assimilation for equitable phonetic remediation in African spheres (Vančová, 2023).

Ultimately, for Malian tertiary students, pronunciation mastery via AI tools is a function of activated, frequent, and conscientious practice. The tables collectively illustrate that while the technology provides the platform, it is the learner's invested behavior spurred by motivation that transforms potential into measurable phonetic gain.

CONCLUSION

This study substantiates a strong and positive correlation between student engagements with AI powered pronunciation tools and significant improvements in English phonetic proficiency among Malian tertiary students. The findings confirm that while AI technology, such as the ELSA Speak application (Kurt, 2022), provides an accessible and adaptive platform for pronunciation practice, it is the learners' sustained behavioral engagement characterized by regular, deliberate, and motivated practice that fundamentally drives learning gains. Participants demonstrated notable pronunciation improvement after the 12week intervention, with engagement metrics strongly predicting these outcomes. Importantly, intrinsic motivation was found to mediate this relationship, supporting the relevance of Self-determination Theory (Chichekian & Benteux, 2022) and highlighting that the tool's effectiveness is enhanced when embedded in a supportive and motivating learning environment. The stronger engagement gain correlation observed among female participants further suggests the influence of sociocultural and interactional factors, aligning with observations in other digital learning contexts (Nazim, 2024).

These results carry meaningful implications for language education policy and practice in resource constrained settings like Mali, advocating for the integration of AI tools into curricula alongside pedagogical strategies that foster motivation and consistent use (Vančová, 2023; Lim & Toh, 2024). This study has several limitations. First, the design lacked a control group, which limits the internal validity of causal claims. While the pre/post-test gains are significant, the absence of a comparable group not using the AI tool means we cannot definitively rule out other factors (e.g., concurrent classroom instruction, maturation) as contributors to the improvement. Future experimental or quasi-experimental studies should incorporate control conditions to strengthen causal inference. Second, the engagement metrics, while objective, were primarily behavioral; future research could incorporate real-time affective and cognitive measures. Third, motivational data were self-reported, which may introduce bias.

The finding of a stronger engagement-gain correlation among female participants warrants deeper investigation. Future qualitative research, employing interviews or focus groups, is recommended to explore the socio-cultural, motivational, and interactional factors that may explain this gender disparity. Finally, the 12-week intervention

period focused on short-term gains; longitudinal studies are needed to examine the long-term retention of pronunciation improvements and the sustainability of engagement.

Ultimately, this research underscores that the transformative potential of AI in language education lies not in the technology alone, but in its capacity to inspire and sustain meaningful learner engagement...

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