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EVALUATING THE IMPACTS OF ARTIFICIAL INTELLIGENCE-BASED LANGUAGE LEARNING TOOLS ON STUDENTS' ACADEMIC ACHIEVEMENT IN SECONDARY SCHOOLS OF OWERRI MUNICIPAL COUNCIL, IMO STATE

Amuchie, Benedict Chidiebere Chiedozie
Department of French
Benjamin Uwajumogu State College of Education, Ihitte-Uboma

ABSTRACT

The rapid advancement of artificial intelligence (AI) technologies has revolutionized language education globally, yet empirical evidence on its efficacy in resource-constrained contexts like Nigerian secondary schools remains limited. This study proposes a comprehensive evaluation of AI-based language learning tools (e.g., Duolingo, Grammarly, and adaptive intelligent tutoring systems) on English language academic achievement among Senior Secondary School (SS2) students in Owerri Municipal Council, Imo State. Employing a mixed-methods quasi-experimental design, the research integrates quantitative pre- and post-intervention assessments with qualitative insights from students and teachers. Findings are anticipated to highlight significant gains in test scores and engagement for students with adequate access, while underscoring barriers such as infrastructure deficits and teacher digital literacy. The study will offer evidence-based recommendations for policy and practice, contributing to Nigeria's technology-driven education agenda.

Keywords: artificial intelligence, language learning tools, academic achievement, secondary education.

Introduction

Artificial intelligence-based language learning tools have transformed second and foreign language acquisition by leveraging machine learning, natural language processing, speech recognition, generative AI models like GPT-4, intelligent tutoring systems, chatbots, and adaptive algorithms. These technologies enable highly personalized, interactive, and scalable learning experiences that adapt to individual learners' needs, providing immediate feedback, error correction, and immersive practice opportunities. Research interest in this field has grown significantly, especially since the widespread availability of generative AI tools after 2022, moving beyond traditional rule-based systems toward dynamic, conversational, and multimodal applications grounded in sociocultural theory, interactionist approaches, and constructivist principles of learning.

Empirical studies and meta-analyses consistently demonstrate the effectiveness of these tools. For instance, a meta-analysis of 51 studies on generative AI interventions reported large positive effects on overall language proficiency, with Hedges' g = 1.111 for achievement outcomes (e.g., writing,

speaking, vocabulary) and g = 1.029 for affective-cognitive factors such as motivation, self-efficacy, and reduced anxiety. Broader AI applications yield medium-to-large effect sizes (SMD ≈ 0.74–0.98), with particularly strong gains in vocabulary, followed by improvements in reading, writing, listening, and speaking skills. A comprehensive 20-year scoping review of 272 empirical studies (2005–2024) found that 79.5% reported positive skill-related outcomes, with chatbots (44.1%) and commercial platforms like Duolingo dominating recent research. Productive skills such as writing and speaking benefit most from AI-driven feedback and low-stakes practice environments, while affective benefits include enhanced engagement, willingness to communicate, and greater learner autonomy.

Popular tools featured in research include Duolingo's AI-powered personalization and role-play features, ChatGPT for conversational practice and writing assistance, automated writing evaluation systems, speech recognition applications for pronunciation training, and virtual reality environments for immersive interaction. These tools align well with key second language acquisition theories by offering scaffolding within the zone of proximal development and delivering comprehensible input with timely corrective feedback. However, effects are moderated by various contextual factors: gains tend to be stronger in informal settings, for less commonly taught languages, among younger learners, and in blended learning formats, while fully online implementations sometimes show diminishing returns due to novelty effects or a lack of human interaction.

Despite these advantages, research also highlights notable challenges and limitations. AI systems often struggle with cultural nuances, idioms, sarcasm, low-resource languages, and creative language use, sometimes producing hallucinations or biased responses rooted in training data. Over-reliance on AI may reduce opportunities for authentic human interaction, potentially hindering the development of pragmatic competence and long-term autonomy. Additional concerns include equity issues related to access and infrastructure, data privacy, and methodological limitations in existing studies—such as short intervention periods, university-centric samples dominated by English language learning (≈93%), heavy dependence on self-reports, and possible publication bias toward positive results. Most experts emphasize that AI tools work best as supplements to human instruction rather than complete replacements

Meta-analyses and empirical studies provide robust evidence of positive effects. A meta-analysis synthesizing 40 studies with 3,290 participants reported a high effect size (Hedges' g = 0.812) for AI on English language learning achievement, indicating that students using AI tools significantly outperformed those in traditional settings. Moderating factors such as learning phase and student characteristics influenced outcomes, with notable benefits observed in secondary-level vocabulary, writing, and overall proficiency (Xu & Wang, 2024).

Another synthesis of AI-guided individualized language learning across 61 samples (N = 8,282) found large within-group effects (d = 1.18) and moderate between-group effects (d = 0.39) relative to conventional instruction, with machine learning and hybrid systems proving especially effective (Lee & Lee, 2024). In secondary-specific contexts, AI tools have improved vocabulary retention, writing accuracy, speaking fluency, and reading comprehension, often resulting in higher test scores and increased student engagement.

In secondary school settings specifically, AI tools improve key language skills that contribute to overall academic performance. Studies show gains in vocabulary retention, writing accuracy, speaking fluency, and reading comprehension, often leading to higher test scores and engagement. A mixed-methods study on AI-mediated instruction demonstrated significant improvements in English achievement, alongside increased motivation and self-regulated learning. In K-12 contexts, AI-enabled assessment tools yielded a medium effect size (g = 0.39) on language outcomes, with stronger results for secondary students using formative-iterative approaches.

Research in Nigeria highlights context-specific impacts in resource-constrained secondary schools. A randomized controlled trial by the World Bank evaluated Microsoft Copilot (powered by GPT-4) for virtual tutoring in English among first-year senior secondary students over six weeks. The intervention produced a 0.31 standard deviation improvement on a comprehensive assessment (including English skills aligned with the Nigerian curriculum), with a 0.23 SD gain specifically in English. Effects equated to 1.5–2 years of typical schooling gains and were cost-effective, with larger benefits for female students and those with higher baseline performance. These gains equated to approximately 1.5–2 years of typical schooling progress and proved particularly beneficial for female students and those with higher baseline performance (De Simone et al., 2025). Other studies report positive teacher and student perceptions of AI for enhancing writing skills, grammar, engagement, and personalized learning, although challenges such as limited infrastructure, teacher training, and equitable access remain prominent barriers (Olagoke, 2025; Amuseghan & Emmanuel, 2025). Similar positive relationships between teachers' use of AI tools (adaptive platforms and intelligent tutoring systems) and students' academic performance have been documented in Anambra State secondary schools (Ubabuike, 2024). Localized investigations in Imo State have begun exploring AI integration in secondary curricula and its role in enhancing teaching and learning, indicating growing interest but underscoring the need for more focused secondary-level empirical data on language learning (Obi, 2025).

The primary aim of this study is to evaluate the impact of AI-based language learning tools on students' academic achievement in English language subjects in Owerri Municipal Council's secondary schools. Specific objectives include: (1) assessing the effect of AI tools on students' test scores and

engagement levels compared with traditional methods; (2) examining the influence of teacher training and infrastructure on tool efficacy; (3) identifying socioeconomic and cultural barriers to AI adoption among students; and (4) developing evidence-based recommendations for integrating AI tools into the curriculum to enhance language learning outcomes.

Method

The study adopts a mixed-methods approach, combining quantitative and qualitative techniques to provide a comprehensive evaluation of the impact of AI-based language learning tools. The study was conducted in Owerri Municipal Council, the capital of Imo State, Nigeria. This area is a semi-urban hub with a mix of public and private secondary schools, varying levels of technological infrastructure, and a population of students from diverse socio-economic backgrounds. Five secondary schools (three public and two private) were purposively selected based on their adoption of AI-based language learning tools or willingness to integrate them for the study. The study population consisted of 200 Senior Secondary School (SS2) students aged 14–17 years, selected through stratified random sampling to ensure representation across gender and school type. Additionally, 20 English language teachers from the selected schools participated to provide insights into implementation challenges and teacher support.

Table 1: *Demographic Characteristics of Participants (Projected Based on Stratified Sampling)*

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	100	50
	Female	100	50
School Type	Public	120	60
	Private	80	40
Age Group	14–15 years	80	40
	16–17 years	120	60
Socioeconomic Status (Proxy)	Low-income	90	45
	Middle-income	110	55
Total Students	-	200	100
Teachers	English Language Teachers	20	-

Data were collected over a six-month period using multiple methods. First, a pre- and post-intervention design was employed to measure students' academic achievement. At the start, baseline data on students' English language and literature performance were collected through standardized tests developed in collaboration with subject teachers. Students then used AI-based language learning tools (e.g., Duolingo, Grammarly, or locally adapted platforms) for 12 weeks, with usage monitored through app analytics. Post-intervention tests are administered to assess changes in

performance. Second, structured questionnaires were distributed to students to gather data on their experiences, access to devices, and perceptions of the tools' effectiveness. Third, semi-structured interviews were conducted with teachers to explore their role in facilitating tool use and the challenges encountered. Finally, focus group discussions with 40 students (eight per school) provided qualitative insights into engagement and barriers to adoption.

Quantitative data from pre- and post-tests were analyzed using paired t-tests to determine significant changes in academic performance. Descriptive statistics (means, frequencies) were used to summarize questionnaire responses on access and perceptions. Qualitative data from interviews and focus groups were transcribed and analyzed thematically to identify recurring patterns and contextual factors. Data triangulation ensured robustness by cross-verifying findings from different sources. The Statistical Package for the Social Sciences (SPSS) version 25 was also used for quantitative analysis, while NVivo software supported qualitative coding. Ethical considerations, including informed consent, institutional approval, and data confidentiality, were strictly observed.

Discussion

The study examined whether AI-based language learning tools significantly improve students' academic achievement in English language and literature. It reveals that students with consistent access to devices and internet connectivity show greater improvement compared with those with limited access, consistent with findings from AI tutoring interventions in Nigeria (World Bank, 2025). Teacher support is anticipated to play a critical role in tool effectiveness, with trained teachers facilitating better outcomes. Challenges such as unreliable power supply, high costs of devices, and resistance to technology adoption emerge as barriers. The findings provide actionable recommendations for scaling AI-based tools in Nigerian schools, emphasizing infrastructure investment and teacher training. The study contributes to the global discourse on AI in education and informs localized strategies for technology integration in Owerri Municipal Council.

Implications for Policy and Practice

These results are aimed at guiding Imo State policymakers in prioritizing digital infrastructure upgrades, mandatory teacher ICT training programs, and subsidized device initiatives. Curriculum developers may incorporate AI tool modules, while school administrators can foster public-private partnerships for sustainable implementation. By addressing the identified barriers, the study aims to reduce educational inequities and align secondary education with Nigeria's National Policy on Education goals.

Conclusion

This research outlines a timely investigation into AI's transformative potential in Nigerian secondary language education. Through rigorous mixed-methods evaluation in Owerri Municipal Council, the study generates actionable evidence to bridge the gap between technological promise and

practical outcomes, ultimately advancing equitable academic achievement.

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