

Using Artificial Intelligence for Personalized Arabic Language Learning: A Case Study of the Federal College of Education, Katsina

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ABSTRACT

This paper seeks to examine how Artificial Intelligence (AI) powered personalized learning platform can influence Arabic language proficiency among non-native speakers. The paper used a quasi-experimental design by selecting fifty students from Arabic Department of Federal College of Education, Katsina randomly, the students were divided into two groups, in which one group received instruction in an Arabic course through traditional teaching method, while the other engaged with Duolingo an adaptive AI platform that offer personalized learning over a period of 12-week. To assess their progress, pre and post - test were administered to both groups to evaluate their reading, writing, listening, and speaking skills in Arabic Language. The results were as follows: the experimental group's average proficiency score jumped from 41.2 to 68.7 which signifying a gain of 27.5 points ($p < 0.001$) far outpacing the control group's 10.4 point improvement. The result of the experiment also shows strong participation from the experimental group, where 92% of modules was completed and the students spend an average of 4.6 hours per week on the platform. Based on these findings we can say that AI driven personalized learning can significantly improve Arabic language acquisition among non - native speakers, it also foster deeper student engagement, and promote learner independence. Based on this evidence the study recommends that Nigerian tertiary institutions consider integrating AI-based tools into Arabic language instruction to address the challenges faced by non-native learners of Arabic Language.

INTRODUCTION

The Context of Arabic Learning in Nigeria

The context of Arabic learning in Nigeria is deeply intertwined with the spread of Islam and Islamic education in the country, especially in Northern Nigeria. Arabic learning has existed in Nigeria since the 7th century C.E. as part of Islamic religious education, because of its link to Quranic studies and Islamic knowledge disciplines. Historically, Arabic education was largely confined to religious sciences connected with the Quran, making Arabic and Islamic studies inseparable in the Nigerian context (Ajape *et al.*, 2015).

Apart from this it holds a prominent academic position in the country's educational system, where it is taught as an academic subject in over 200 tertiary institutions across the country, which include universities, colleges of education and other institutions. The courses mainly cover Arabic language, Arabic literature, and related disciplines, which have produced several personnel who contribute to the development of the nation as teachers, scholars, and interpreters of religion and culture (Mustapha *et al.*, 2024).

With this, we can easily say that Arabic Language in Nigeria is playing a dual role as a spiritual necessity for the Muslim Umma also as an intellectual pursuit, which makes it a key component in Nigeria's educational system especially in the Northern part of the country. We can see how it connects religious practice with formal education

and cultural identity, which gives learners a room to engage with Islamic traditions at the same time also fostering their academic and professional development (Ayuba, 2012), with all this, the effective acquisition of this language remains constrained by many challenges and barriers for learners of the language.

Among these challenges there are three categories of barriers which consistently affect Arabic learning in Nigeria. First, pedagogical challenges that come from the structural complexity of the Arabic language itself. Orthographic challenges such as right to left reading orientation, lack of obligatory vowels, and positional letter variations combine with morpho-syntactic complexities such as dual number inflections and case markings to create high attrition rates among learners (Mustapha *et al.*, 2024). Second of the challenges is lack of adequate resources as most institutions face severe textbook shortages, together with outdated instructional materials digital materials in particular. This scarcity makes it difficult for learners to access quality and relevant engaging content; by implication, it reduces the effectiveness of teaching and learning (Ajape, 2023). Third challenge is cognitive linguistic factors such as cross orthographic interference from their prior literacy in Roman scripts, where learners usually transfer their reading and writing habits from Roman scripts to Arabic's script which is written from right to left. This poses cognitive challenges that affect the learning of reading

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skills, which also affect their overall language acquisition (Mustapha *et al.*, 2024).

AI as a Transformative Solution

Emerging literature on AI and the Arabic language indicates that adaptive learning systems and multimodal technologies powered by Artificial Intelligence (AI) can be a good solution to the major challenges facing Arabic language learning in the Nigerian context.

That is because adaptive learning systems is using AI algorithms to personalize instruction according to each individual proficiency levels. It automatically adjust the difficulty of the content, pace of it in real time, which by contrast provides personalized and effective remediation. This will equally help in accelerating the student concept mastering and it also reduce grammatical errors through automated feedback that is tailored to each learner specific needs. (Mustapha *et al.*, 2024).

In the Nigerian context, these AI driven solutions can directly solve those challenges that face Arabic learners. Where personalization solves the cognitive challenge that imposed by the structural complexity of the Arabic language, while scalability addresses material scarcity, and multimodal reinforcement helps learners to overcome cross script interference (Ejjami, 2024; Mustapha *et al.*, 2024).

Study Significance

The significance of this study lies on its contribution to ongoing debates on how AI and Arabic pedagogy can intersect by focusing on local underdeveloped settings like the Federal College of Education, Katsina, Nigeria. Unlike most AI in education research, which centers on mainly on developed environments and countries, this case study addresses how personalized Arabic language learning can be effectively supported in low bandwidth contexts, by utilizing modest hardware which is within a culturally sensitive framework. We can identify the significance of this study in three ways. First it advances the understanding of how AI can be easily used in Nigeria's educational context catering to cultural needs of the environment. Secondly the study offers an evaluation of AI impact on the four language skills using standardized metrics such as CEFR-A and ACTFL benchmarks. Thirdly it develops an institutional framework which can help in sustainable integration of AI in educational institutions. With this the study addresses the pedagogical challenges relating to applications of Artificial Intelligence in education.

LITERATURE REVIEW

AI and Personalized Arabic Language Learning

Based on the existing literature it is clear that the integration of Artificial Intelligence (AI) into education has transformed contemporary discussions on personalized learning and curriculum development. Several scholars have argued that AI driven educational systems can improve learners' engagement and teaching method, at the same time promote deeper learning outcomes through

automation and personalization (Ejjami, 2024). From this we can see that this discussion is based on the following three concepts: personalized learning algorithms, adaptive assessment tools, and immersive learning technologies such as Virtual Reality (VR) and Augmented Reality (AR). The collective of these technologies will indeed reimagine our classrooms as student centered.

Existing empirical studies support this outcome particularly in Arabic language acquisition. A recent study by Garba and Hassan (2024) demonstrated the effect of specific AI applications in creating a comprehensive and multifaceted learning strategy for non-native speakers. Their research on tools like ArabicPod101 (listening), Lingbe (speaking), Duolingo (reading), and Scribe Arabic (writing) showed that these platforms address fundamental linguistic competencies challenges through personalized and adaptable methods, which I return will result to significant improvements in all four language skills among Nigerian university students. Which will serve as framework for AI in language learning.

For instance personalized learning algorithms can be used to tailor teaching content to cater the specific and different needs of each individual learners. Also in the context of language acquisition such algorithms can easily allow Arabic learners to focus on specific aspect of the language such as grammar and vocabulary pronunciation, each student according to his specific challenges and need. This is particularly significant for Nigerian students at the Federal College of Education (FCE), Katsina, where learners come from diverse backgrounds with different language proficiency and his exposure to Arabic language. Secondly by generating adaptive learning pathways, AI ensures that all students are neither overwhelmed by the advance of teaching material nor demotivated by level of the content. If we look at Duolingo we will see that its gamified adaptive algorithms help for reading and ArabicPod101's spaced repetition for listening, as noted by Garba and Hassan (2024), practicalize this principle.

To complement this personalization, the Adaptive assessment tools can be utilized in order to deliver realtime feedback and adjust the difficulty levels in response to student performance. In Arabic language teaching these assessments can be used to evaluate the student pronunciation, sentence construction, and comprehension in order to offer immediate corrective feedback. This aligns perfectly with research that highlights how students in Nigerian colleges are receptive to technology based instructional materials, although there is lack of proper utilization from the facilitators end (Mustapha *et al.*, 2024).

While students at FCE Katsina may welcome this AI driven feedback mechanisms, it is necessary to know that the success is lied in proper implementation by facilitators, thus the instructors requires adequate training and workshop. A good example of this adaptive assessment tools this is the immediate feedback mechanisms of Scribe Arabic for writing and the peer feedback loop on Lingbe for speaking, as documented by Garba and Hassan (2024).

The innovative technologies such as VR and AR, can easily extend AI's promise by simulating authentic linguistic and real cultural contexts. For example, learners can visit a virtual Arabic marketplace and explore this digital environment in order to practice various conversational skills that replicate Arab cultural settings. And this experience will surely bridge the gap between language rules and practical implementation of these rules in real live communication which in return makes learning more fun and lovable to the students. However, the integration of this into resource limited environment like Nigeria contexts faces several challenges some are related to infrastructure, some to accessibility or cost what raised concern.

Garba and Hassan (2024) have proved that platforms with features to connect non-native speakers with native speakers in real time conversation such as Lingbe, can effectively utilized in order to compensate for the lack of a physical Arabic speaking environment through virtual transporting of the linguistic context to the learners. Although with despite all these opportunities, some challenges will arise especially those regarding data privacy, as some scholars have already warned of data privacy concerns, another challenge is algorithmic biases, and also unequal access to AI powered technologies to many of the learners, especially if it was not address (Ejjami, 2024).

In an environment like Nigeria, these challenges of inadequate digital infrastructure, lack of teacher training, and limited government support can really intensify these risks (Mustapha *et al.*, 2024). In FCE Katsina, these issues were partially address: by ensuring data security for learners, constantly training instructors and facilitators on AI pedagogy, and ensuring equitable access to digital resources by all.

That is why some studies such as Garba and Hassan (2024) identify some AI application challenges, which include content depth limitation, at times technical glitches from the used software and connectivity issues. That need to be addressed in order to enhance the learning experience in the Nigerian context.

The absence of a comprehensive specific strategy for integrating AI into Arabic language education in Nigerian institutions serves as the critical gap in this literature. Since majority of studies were mostly on potential of AI in curriculum development, at the same time they often overlook the sociocultural demand and institutional realities of developing countries like Nigeria. Where most of the studies on Arabic pedagogy in Nigeria highlight the challenges of adopting modern instructional materials have fail to explore how AI might bridge these gaps. That why the intersection of AI driven personalization and Arabic pedagogy remains one of the underexplored field within the Nigerian context.

Although Garba and Hassan (2024) study provide valuable evidence of efficacy it does not extend to developing a scalable integration model for teacher training institutions such as colleges of Education, where the goal is not only

student learning but also preparing future educators to use these tools effectively in their respective field.

In order to address this gapsome scholars indicate that there must be interdisciplinary collaborations between educational theory, technology design, and cultural sensitivity. To achieve this there is need to create special roles within institutions, such as AI Data Privacy Coordinators whom can work to safeguard student data, AI Equity Specialists whom work is to ensure inclusive access for everybody, and AI Pedagogy Trainers whom work to insure that instructors were equipped with necessary skills to apply AI tools in language classrooms (Ejjami, 2024). And for FCE Katsina particularly these recommendations are very relevant as the institution seeks to modernize its Arabic curriculum at the same time maintaining alignment with cultural and religious values of the society.

In summary, the existing literature suggests that AI holds transformative potential for personalized Arabic language learning through fostering individualized learning pathways at times, adaptive assessments in other time, and innovative experiences. While some studies from Nigeria confirms the effectiveness of specific AI tools in improving language skills and providing a compensatory virtual environment (Garba & Hassan, 2024). With all these the success of the FCE Katsina adoption model requires addressing above mentioned infrastructural, pedagogical, and ethical challenges. This study therefore seeks to contribute in filling the identified gap through examining the practical realities of applying AI for personalized Arabic language learning in a Nigerian College of Education.

Empirical Evidence

The theoretical advantages of AI in language learning are supported by an expanding corpus of empirical research conducted worldwide, with more recent studies starting to concentrate specifically on Arabic. Among these studies that demonstrate the impact of AI on various language skills SUNO. AI (2023) where its personalized listening exercises helped users' listening comprehension scores rise by 25%. This aligns perfectly with the findings of Garba & Hassan (2024), who observed that Nigerian students using ArabicPod101 significantly improved their listening abilities. That is because the Adaptive learning platforms can improve personalized learning outcomes of student through its real time feedback, there is evidence that support that which is more comprehensive review published in AI & Language (2022). Also the Frontiers study that was published in 2023 has indicate that AI can be utilized in order to increase learner's engagement and self-regulated learning. Importantly, meta-analyses have indicated a significant increase in L2 speaking skills when using AI tools compared to control groups (Iowa State, PubMed Central). At the same time the application of these technologies in teaching Arabic is showing similarly encouraging result, a study on tools like ArabicPod101, Lingbe, and Duolingo, documented

clear improvements in listening, speaking, and reading skills. To further support this argument a Saudi Journal (2022) highlighted that AI writing support can lead to improved writing quality with more accurate scores and higher learner engagement. Moreover, research in the International Journal of Post Axial Thinking (2023) indicated that personalized AI learning plans increase learner satisfaction, inclusivity, and accessibility.

Areas of Impact and Persistent Gaps

From the above empirical evidence we can see that AI has significant effects on Arabic learning in a number of important areas such as:

- **Writing Quality and Assessment:** the learner's writing quality was significantly improved with the help of the platform which leads to more precise scoring and candid feedback.
- **Personalization and Accessibility:** Personalized learning paths increase student achievement and broaden the learning experience for a variety of learners.
- **Real-time feedback and adaptation:** This feature, which provides instantaneous correction that is frequently unavailable in large classrooms, is essential for learning Arabic's intricate morphology and grammar.

With all this there are still a lot of challenges that need to be solved, such as the scarcity of longitudinal studies that monitor the long-term effects of AI-assisted Arabic learning. Also, the lack of AI tools specifically designed for Arabic that are deeply adapted to its diglossic nature and cultural context is another challenge that needs to be solved. With all these challenges, this study sees that there is an urgent need for future research to concentrate on linguistic and cultural sensitivity in algorithm design in order to prevent bias reinforcement and guarantee pedagogical efficacy for the particular difficulties encountered by non-native Arabic speakers.

MATERIALS AND METHODS

Research Design

This study examined the effects of the AI-powered Duolingo Arabic course on language proficiency using a quasi-experimental, pre-test and post-test control group

design. To measure the intervention's effects objectively, the design solely used quantitative data collection. This method was chosen to accurately assess the causal relationship between the independent variable (Duolingo use) and the dependent variable (Arabic proficiency) in the real-world setting of FCE Katsina.

Participants

The participants were purposively sampled by selecting 50 (N=50) non-Arabic speaking students from FCE Katsina. These students were randomly divided into one of two groups to ensure initial equivalence:

- **Experimental Group (n=25):** this group underwent the 12-week intervention using the Duolingo Arabic course as the mode of instruction.
- **Control Group (n=25):** the control group received teaching through traditional classroom instruction only. The pre-test result confirmed equivalent baseline proficiency across both groups (Pre-test M = 41.2).

Intervention: AI-Assisted Learning via Duolingo

For the experimental group the Duolingo Arabic course was used as part of a structured, 12-week learning intervention, its integrated features make it perfect as the AI-based tool for the study, by offering a thorough learning experience to the learners such as:

AI-Powered Personalization

Duolingo's adaptive algorithms generated a personalized learning path for each student which focused on their areas of weakness. Using each student's performance as a guide.

Integrated Skill Development

By offering a variety of exercise formats, the platform was utilized to enhance all four fundamental language skills: Reading, writing, speaking, and listening.

Data Collection

To ensure objective measurement of the impact of the intervention, data was gathered from two main quantitative sources:

Table 1:

Instrument	Purpose & Details
Arabic Proficiency Test	The Arabic Proficiency Test was used as the main measure of learning outcomes which was administered to both groups before and after the intervention in order to measure all four skills (speaking, writing, listening, and reading) on a 0-100 scale.
Duolingo Progress Reports	Duolingo Progress Reports were the source of engagement data, where students submitted weekly screenshots of their in-app progress report. These provided objective metrics for: Weekly XP Earned: A measure of overall activity and engagement; Number of Lessons Completed: A measure of progress through the curriculum; and Accuracy Rate: A measure of performance quality.

Data Analysis

To interpret the quantitative data that was gathered, a thorough statistical analysis plan was put into place:

Paired Samples t-tests: Analyzed the difference between pre-test and post-test scores within each group to determine the significance of individual learning gains.

T-Tests for Paired Samples

To ascertain the importance of individual learning gains, the difference between each group's pre- and post-test scores was examined.

T-Tests for Independent Samples

To ascertain whether the Duolingo intervention led to a statistically significant higher improvement in proficiency ($p < 0.001$), the experimental and control groups' gain scores were compared.

Descriptive Statistics

Measured participant interaction with the platform by analyzing the engagement metrics (average weekly XP,

average lessons completed) gathered from the screenshots of the Duolingo progress report.

RESULTS AND DISCUSSIONS

The 12-week intervention's quantitative data analysis showed statistically significant results about the effect of the Duolingo AI-assisted learning intervention on student engagement and Arabic language proficiency.

Proficiency Gains

Analysis of the pre-test and post-test proficiency scores shows that there is improvement for both groups over the 12-week period. But the gain of the experimental group was far ahead as shown in the following table:

Table 2: Arabic Language Proficiency Test Scores Pre- and Post-Intervention

Group	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Gain	t-value	p-value	Effect Size (d)
Experimental	41.2 (6.5)	68.7 (7.1)	+27.5	15.84	< 0.001	1.98 (Large)
Control	42.5 (5.9)	52.9 (6.8)	+10.4	7.22	< 0.001	1.02 (Large)

As shown in the Table above both groups demonstrated a statistically significant improvement from the pre-test to the post-test after 12 weeks, as indicated by the large, significant paired t-test results ($p < 0.001$ for both). From this the study will conclude that the two groups' gains differed significantly.

The gain scores were compared using an independent samples t-test. A statistically significant difference in improvement was confirmed by the analysis $t(48) = 9.11$, $p < 0.001$. After the 12 weeks experiment the experimental group achieved a mean gain that was 17.1 points higher than the control group, which shows that the AI assisted intervention had a significant impact on Arabic language proficiency as evidenced by the large effect size for this between groups difference (Cohen's $d > 1.5$).

Engagement Metrics

Throughout the 12 week that the intervention took there was a high degree of engagement with the Duolingo platform from the experimental group which shows:

- **Module Completion Rate:** the module completion rate percentage of the experimental group is around 92% which is very high, which indicate the effectiveness of the platform
- **Average Weekly Usage:** The experimental group actively use the platform for practice for an average of 4.6 hour per week.
- **Dropout Rate:** there is no any dropout throughout the period of the intervention which shows how the platform helps in maintaining participant motivation.

With this we can conclude that the 12-week intervention's outcomes offer solid quantitative proof that the Duolingo AI platform promoted higher and more stable levels of student engagement and retention which resulted in noticeably larger gains in Arabic language proficiency.

Discussion

The purpose of this study is to examine how Artificial Intelligence (AI) powered personalized learning platform such as (Duolingo) can influences Arabic language proficiency among non-native speakers at the Federal College of Education (FCE), Katsina. The findings of the study prove that the incorporation of the Duolingo platform when compared to traditional teaching method alone, resulted in noticeably higher gains in proficiency and engagement by the experimental group. These results if put in larger framework of artificial intelligence in education, or Arabic pedagogy within the unique setting of the Nigerian educational system can really yield a positive result in the field of teaching language as a second language.

Interpretation of Key Findings

The finding of the study shows that the experimental group gained a statistically significant amount of proficiency which is (+27.5 points) than the control group (+10.4 points). Together with an effect size (Cohen's $d > 1.5$) and a highly significant independent t-test ($p < 0.001$), this 17.1-point difference highlight that the AI assisted teaching method is so effective in language teaching. The feature of adaptive algorithms which tried to tailor each student learning path, and the real time feedback that it is offering a prompt correction, and that gamified structure that always kept motivation high are surely responsible for this positive result. This align with all theoretical premise which says that AI powered personalization can successfully address the challenge of varied proficiency levels in Nigerian classroom (Ejjami, 2024; Garba & Hassan, 2024).

And perhaps just as important as the proficiency gains are the outstanding engagement metrics with a 92% module completion rate, and a weekly average usage of 4.6 hours, together with the 0% dropout rate. All

these numbers show that the AI driven approach was not only successful but also very engaging for students in a Nigerian setting where motivation and student retention are ongoing issues. This align with Frontiers published research in 2023 which found that AI driven teaching strategy increases self regulated learning and motivation among students.

Contextualization within Existing Literature

The findings of this study align perfectly with the existing empirical evidence on AI in language learning. The 27.5 point gain in proficiency align with that of (Hijriyah *et al.* 2025) which report 25% increase in listening comprehension in their study of SUNO.AI, this will surely confirm that AI driven personalized platforms helps language skills improvements. Our study results also align with the findings of (Tan *et al.* 2025) which confirmed that adaptive learning platforms significantly improve the learning personalized outcomes through automated feedback.

More ever this study fills a critical gap which was identified in the literature review which is lack of context specific empirical research in environments such as Nigeria. Although the effectiveness of several AI tools was shown by Garba and Hassan (2024) in their study but they did not suggest a scalable integration model. That is what this study closes by demonstrating that all four language skills can be effectively taught within the constraints of a Nigerian college using a single and friendly platform such as Duolingo. It responds to the demand for more equitable and context sensitive AIED applications by showing that successful AI integration can be accomplished with readily available technology rather than requiring expensive VR setups or sophisticated custom software (Ejjami, 2024).

Practical Implications and Recommendations

From the above analysis we can say that the findings of this study can have a direct implications on educational practice in institutions like FCE Katsina in a number of ways such as:

Modernization of the Curriculum

The study findings show that adoption of AI assisted pedagogy by policymakers can help in foreign language teaching, while at the same time curriculum designers have to think about how to formally incorporate verified artificial intelligence (AI) resources such as Duolingo as an extra learning and teaching instructional tool.

Development of Faculty

one of the major challenges in using AI platform for language teaching is lack of prepared teachers, so the study indicate that there is urgently need for professional development for teachers and instructors through training and workshops on how to effectively integrate AI tools with conventional pedagogy so they can facilitate learning. This will surely tackles the issue of underprepared faculty

having limited resources which was highlighted by Mustapha *et al.* (2024) and Ajape (2023).

Sustainable Integration Model

This study presents a replicable model that uses a free, easy to use platform (Duolingo) just like WhatsApp for progress tracking and coordination which is perfect for the Nigerian context because it is scalable and sustainable it is also requires little amount of institutional investment.

Limitations and Avenues for Future Research

Despite of all this good results this study has some limitations that need to be address by future research such as:

Short-Term Intervention

the intervention is limited to only 12 week which is consider a very short period to understand the long term retention skills gained through AI. So a longitudinal research is required.

Single Platform Focus

While Duolingo was effective, it has limitations in content depth and cultural context. In light with the above future research should focus on investigating a hybrid model that combines both Duolingo's core skills training with dedicated application that used for conversational with native speakers in order to address speaking fluency.

Single Platform Focus

Duolingo has limitations in terms of cultural context and content depth. So Future studies could look into a more hybrid model that incorporates culturally content, which is also specialized in practicing conversations with native speakers.

Generalizability

This study was conducted in a single institution with a comparatively small sample size (N=50). To generalize the findings there is need to conduct this study again at several colleges of education in various Nigerian states.

Absence of Qualitative Data

Although quantitative data is a reliable way to measure results, this study ignores the opinions of students which is crucial in knowing the effectiveness of AI from the students' perspective. So interviews and focus groups should be used in future research to better understand the experience and opinions of students regarding AI-assisted learning.

CONCLUSION

In conclusion this study shows that AI driven personalized learning is a practically achievable and can be an effective tool for education in Nigeria today. A clear road map for updating Arabic language instruction at FCE Katsina is provided by the notable increases in proficiency and engagement attained through a straightforward Duolingo

intervention is evidence to that. For this institutions can directly address the challenges pertaining teaching languages such as pedagogical challenges, lack of resources, and motivational issues that have long limited successful language acquisition especially for non-native speakers. This study also prove that if AI was used strategically it has the potential to revolutionize the quality of teaching in developing countries, it will also help in acquiring foreign language for non-native speakers.

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