Original Article

Responsive Use of Artificial Intelligence in Kiswahili Language Learning to University Students in Kenya

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ABSTRACT

Many university students in Kenya are increasingly using AI tools for language learning, despite resistance from lecturers and university management, who discourage their use. While students often rely on AI to complete tasks quickly, they lack proper guidance on how to use these tools effectively, leading to misuse. Even when instructed not to use AI, students continue to do so in secret, a common challenge in educational settings. This presents a challenge for both educators and students, as AI has the potential to significantly enhance learning when used correctly. This study aimed at exploring the responsive use of AI in Kiswahili language learning, proposing effective strategies to guide students in using AI responsibly, ensuring they maximize its benefits while avoiding the pitfalls of misuse. The study utilized a quantitative research design. A total of 200 students from Kibabii University were included in the study. Data was collected using an online questionnaire and analyzed descriptively to provide a detailed summary of the findings. The findings reveal that AI tools significantly enhance language learning through personalized lessons, real-time feedback, adaptive assessments, and virtual tutoring. However, challenges such as high costs, limited access, and technical barriers hinder effective adoption. The study recommends improving accessibility, enhancing customization, and integrating AI tools into curricula while addressing data privacy and inclusivity concerns. These measures aim to optimize the benefits of AI, making Kiswahili language learning more effective and accessible for university students.

INTRODUCTION

The integration of Artificial Intelligence (AI) into education has transformed the way students learn, particularly in language acquisition. AI tools, such as virtual tutors, adaptive learning platforms, and speech recognition software, have enhanced traditional teaching methods by offering innovative, responsive, and personalized learning experiences. Kovalenko and Baranivska (2024) highlighted that AI tools are capable of tailoring educational content to individual learners' needs, fostering engagement, and improving overall learning outcomes. Similarly, Chen *et al.* (2024) emphasized that AI-enabled assessments provide valuable real-time feedback, enabling students to identify and address their weaknesses effectively. These advancements have positioned AI as a critical tool for addressing the diverse challenges faced by language learners in modern education.

Despite these advancements, incorporating AI in language education is not without its challenges. Crompton *et al.* (2024) identified issues such as accessibility barriers, lack of teacher training, and technological limitations that hinder the effective use of AI tools. Jie and Kamrozzaman (2024) further noted that higher education students often struggle with adapting to AI-powered tools due to limited digital literacy and resource constraints. While these studies underscore the potential and limitations of AI, there remains a need to explore how university students, particularly those in resource-constrained contexts, utilize AI tools in their Kiswahili language learning journey. This highlights the importance of investigating AI's role in providing responsive and effective solutions for language acquisition.

This study sought to address the gaps identified in previous research by focusing on how university students use AI tools to enhance their language learning experiences. Specifically, it investigates the role of AI in providing personalized learning paths, real-time feedback, adaptive assessments, virtual tutoring, and speech recognition support. By focusing on students at Kibabii University, this study aims to contribute to the growing body of knowledge on AI in education, providing insights into how these tools can be effectively leveraged to address Kiswahili language learning challenges in higher education contexts.

LITERATURE REVIEW

Theoretical Framework

The study was guided by Social Constructivism Theory, which explains that learning happens best through interaction and collaboration with others. This theory, introduced by Lev Vygotsky in the early 20th century, highlights the importance of social connections and guidance in helping learners improve. A key idea in this theory is the Zone of Proximal Development (ZPD), which refers to tasks a learner can do with support but not yet independently. This guidance, or scaffolding, is crucial in helping students reach their full potential (Ghani, Jamian, & Jobar, 2022).

In this study, Social Constructivism is a good match for understanding how AI tools, such as chatbots and virtual tutors, help university students learn languages. These tools act as guides, providing feedback and helping students learn step-by-step. Szabó and Csépes (2023) explain that teaching methods based on this theory encourage active participation, which AI tools also support by making learning engaging and interactive. Social Constructivism also emphasizes learning through interaction. AI tools create opportunities for students to practice language skills in realistic settings, such as through simulated conversations or group activities. Shah (2022) highlights that Vygotsky's theory shows how important social interactions are for learning, which is exactly what AI tools offer in Kiswahili language learning.

Empirical Review

Personalized learning paths refer to the use of AI to tailor language learning experiences based on individual needs. Kovalenko and Baranivska (2024) explored how AI tools create personalized education by analyzing learners' strengths and weaknesses, enabling them to focus on areas needing improvement. Their study involved systematic analysis and found that AI enhances motivation by adapting to each learner's pace and preferences. Similarly, Chen *et al.* (2024) conducted a meta-analysis showing that AI-enabled personalization

leads to improved language proficiency by providing customized lesson plans. While these studies highlight the potential of personalized learning, they focus mainly on general benefits, leaving a gap in understanding its specific effectiveness in university-level language learning. This research aims to address that gap by evaluating AI's role in providing responsive and individualized support to university students.

Real-time feedback is a significant advantage of AI in language learning. Ji, Han, and Ko (2023) reviewed the collaboration between conversational AI and teachers, emphasizing that real-time feedback from AI tools improves student engagement and comprehension. Their findings indicate that immediate corrections help students learn from mistakes more effectively. Karataş *et al.* (2024) investigated ChatGPT's impact on foreign language learners and found that real-time feedback fosters a supportive environment for practising language skills. Despite these insights, there is limited research on how real-time AI feedback influences long-term language retention. This study seeks to explore this aspect, especially in the context of university students' continuous learning processes.

Adaptive assessments involve AI modifying the difficulty of tasks based on a learner's progress. Chen *et al.* (2024) systematically reviewed AI-enabled assessments in language learning, highlighting their effectiveness in reducing test anxiety and improving performance accuracy. Kovalenko and Baranivska (2024) also noted that adaptive assessments provide a fair evaluation of learners' abilities, as tasks are aligned with their skill levels. However, these studies primarily discuss assessment design and effectiveness, with limited focus on their practical implementation in university settings. This research addresses this limitation by examining how adaptive AI assessments influence students' academic performance in language courses.

Virtual language tutors simulate human teachers, providing guidance and support to learners. Crompton *et al.* (2024) explored the benefits of AI-language learning tools, such as virtual tutors, and found that they offer accessible, cost-effective language practice. Patty (2024) focused on how virtual tutors can complement traditional teaching methods by providing 24/7 availability and interactive learning. Although these studies demonstrate the potential of virtual tutors, they do not extensively evaluate how their use impacts student-teacher interactions or classroom dynamics. This study aims to fill this gap by analyzing how university students balance the use of virtual tutors with in-person language instruction.

AI tools with speech recognition capabilities provide pronunciation practice by analyzing spoken language and offering corrections. Karataş *et al.* (2024) examined how AI-powered tools improve pronunciation, particularly in non-native speakers, by identifying specific phonetic errors. Godwin-Jones (2022) emphasized that such tools enhance fluency and accuracy by mimicking conversational scenarios. While these studies highlight improvements in pronunciation, they do not assess how speech recognition tools handle diverse accents and linguistic backgrounds. This research investigates the inclusivity of AI tools in pronunciation practice, focusing on university students from multilingual environments.

Despite its benefits, AI in language learning faces challenges. Crompton *et al.* (2024) reviewed the technical and pedagogical difficulties of integrating AI in English language teaching, including accessibility issues and the lack of teacher training. Jie and Kamrozzaman (2024) analyzed higher education students' challenges in using AI, noting that technical issues and limited digital literacy hinder its effectiveness. These challenges suggest that successful AI implementation requires institutional support, robust infrastructure, and ongoing training. This study contributes by identifying specific barriers university students face and proposing practical solutions to enhance AI adoption.

The existing literature has provided valuable insights into the advantages and challenges of AI in language learning. However, most studies focus on general applications or specific aspects like adaptive assessments or pronunciation practice. There is limited research on the holistic impact of AI on university-level language learning, particularly in combining personalized learning, real-time

feedback, adaptive assessments and speech recognition. This study fills this gap by examining how AI tools, when used responsively, can create an integrated and effective learning environment for university students. By doing so, it provides actionable recommendations for improving language education through AI technologies.

RESEARCH METHODOLOGY

The study employed a quantitative research design with a descriptive survey approach to examine the impact of responsive AI use in Kiswahili language learning among university students at Kibabii University. The university was purposefully selected due to its diverse student population and integration of technology in language studies. The target population comprised students enrolled in Kiswahili-related courses, with a sample size of 200 students determined using Krejcie and Morgan's (1970) formula from an estimated 500 students. A purposive sampling technique was used to ensure representation across first-year to fourth-year students. Data was collected through a questionnaire, designed to capture students' experiences, perceptions and academic outcomes related to AI tools in Kiswahili learning. The questionnaire included sections on demographics, AI effectiveness, usability and impact on language proficiency. This approach ensured efficiency, wide reach and anonymity, encouraging honest responses. The collected data were analyzed descriptively, utilizing frequencies and percentages with findings presented in tables, graphs and charts to provide a clear summary of the study results.

FINDINGS AND DISCUSSIONS

This section presents the main results from the study, showing how AI tools are used in Kiswahili language learning. It looks at their ability to provide personalised lessons, instant feedback and adaptive assessments. It also discusses the role of virtual tutors, speech recognition and the challenges faced by users, while suggesting ways to improve these tools.

Background Information

This section presents the demographics of the respondents who participated in the study. It highlights their gender, year of study and subject combinations, providing an overview of the participants' background.

When asked about their gender, 60% of the respondents indicated they were male (120), while 40% were female (80). This suggests that more males are using AI tools for Kiswahili language learning compared to females, reflecting a possible trend in technology adoption between the genders within the study population.

When asked about their year of study, 60% of the respondents were in their fourth year (120), 15% were in their second year (30), 15% were in their third year (30), and 10% were in their first year (20). The high representation of fourth-year students suggests that senior students are more engaged with AI tools, likely due to their advanced academic demands and familiarity with technology. In contrast, the lower participation of first-year students may reflect limited exposure to or awareness of AI tools, emphasizing the need for targeted orientation for early-year students to encourage technology adoption.

When asked about their area of study, the respondents were distributed as follows: 40% were Kiswahili/CRE students (80 respondents), 30% were Kiswahili/History and Government students (60 respondents), and 30% were Kiswahili/Geography students (60 respondents). The high representation from Kiswahili/CRE students suggests a significant engagement with AI tools, likely due to the pedagogical alignment of Kiswahili and CRE, which emphasizes structured language application in education. The balanced participation from Kiswahili/History and Government and Kiswahili/Geography students highlights the relevance of AI tools in supporting analytical and contextual learning within these subject combinations.

Personalized Learning Paths

Personalised learning paths are a key feature of AI tools, as they adjust lessons to fit each learner's progress and needs. This part looks at how often students use these tools and how well they personalise lessons to help improve learning.

When the respondents were asked how often they use AI-based language learning platforms, their engagement levels varied where, 34 (17%) were daily users, 36 (18%) were weekly users, 44 (22%) were monthly users, 44 (22%) used them rarely, and 42 (21%) never used them as depicted in Figure 1 below:

Figure 1: Frequency of AI Tools Used for Language Learning

Frequency of AI Tool Use for Language Learning
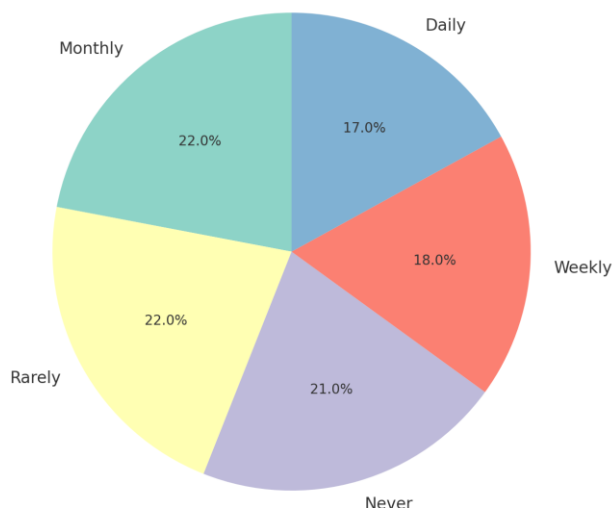
These findings are in line with Godwin-Jones (2022) who said that frequent users (daily) benefit the most from AI tools, as consistent practice enhances vocabulary, grammar, and pronunciation skills. Moderate users (weekly and monthly) often adopt a hybrid approach, combining AI tools with traditional learning methods, ensuring steady but not intensive progress. Infrequent users (rarely and never) may face barriers such as technological access, unfamiliarity, or scepticism about AI's effectiveness, limiting their ability to fully leverage these tools.

To maximize the benefits of AI tools for Kiswahili language learning, targeted interventions are necessary. These could include increasing accessibility, raising awareness about the tools' advantages, and addressing usability concerns. Such strategies can help encourage higher engagement across all user groups, ensuring broader and more consistent use of AI-based language learning platforms.

When asked about the AI-based language learning platforms they have used, the respondents reported the following preferences, as shown in Table 1:

Table 1: AI-based Kiswahili Language Learning Platform Used by Respondents

AI-Based Platform	Number of Respondents	Percentage (%)
Duolingo	50	25
Babbel	20	10
Rosetta Stone	15	7.5
Busuu	10	5
Lingvist	5	2.5
Memrise	20	10
HelloTalk	10	5
ChatGPT	40	20
ELSA Speak	20	10
Mondly	5	2.5
Other	5	2.5
Total	**200**	**100**

Table 1 shows that Duolingo (25%) is the most widely used AI-based Kiswahili language learning platform, followed by ChatGPT (20%), while other platforms like Memrise, ELSA Speak, and Babbel have moderate usage (10% each), and niche platforms like Lingvist and Mondly are the least used (2.5% each).

The findings indicate that Duolingo's popularity stems from its gamified and user-friendly approach, while ChatGPT's conversational AI capabilities make it a strong contender for interactive learning. Moderate usage of platforms like Memrise, ELSA Speak, and Babbel highlights the demand for tools focused on vocabulary and pronunciation, whereas lower adoption of niche platforms like Lingvist and Mondly suggests limited awareness or specialized use cases among learners.

When asked whether AI tools customize lessons based on their performance, 30% of respondents indicated that the tools always adapt lessons, 25% said they often do, 20% reported occasional customization, while 15% and 10% stated that customization happens rarely or never, respectively, as seen in Table 2.

Table 2: Lesson Customization Frequency

Customization Frequency	Number of Respondents	Percentage (%)
Always	60	30
Often	50	25
Sometimes	40	20
Rarely	30	15
Never	20	10
Total	**200**	**100**

These results indicate that most respondents (75%) experience consistent or frequent customization, suggesting that many AI tools effectively adapt lessons to individual performance. However, the 25% who reported occasional or no customization highlight potential limitations in some tools' adaptive capabilities, possibly due to less advanced algorithms or insufficient user input. These findings emphasize the need for continuous improvement in AI platforms to ensure reliable and consistent personalization for all users.

When asked whether AI tools customize lessons based on their performance, 30% of respondents indicated that the tools always adapt lessons, 25% said they often do, 20% reported occasional customization, while 15% and 10% stated that customization happens rarely or never, respectively, as seen in Table 3.

Table 3: Lesson Customization Frequency

Customization Frequency	Number of Respondents	Percentage (%)
Always	60	30
Often	50	25
Sometimes	40	20
Rarely	30	15
Never	20	10
Total	**200**	**100**

The findings reveal that most respondents (75%) experience consistent or frequent lesson customization, indicating that many AI tools effectively adapt lessons based on user performance. However, the remaining 25%, who reported occasional or no customization, suggest potential gaps in some tools' adaptive mechanisms, possibly due to limited algorithms or insufficient user input.

These results are consistent with findings by Schmidt and Strasser (2022), who highlight the

importance of intelligent practice in AI-driven language tools. Their research emphasizes that effective customization relies on advanced algorithms to track performance and dynamically adjust content, ensuring a more personalized and engaging learning experience.

When asked about the effectiveness of personalized AI learning tools, 40% of respondents rated them as very effective, 30% as moderately effective, 20% as slightly effective, and 10% as not effective, as shown in Figure 2.

Figure 2: Effectiveness of Personalized AI Learning Tools.
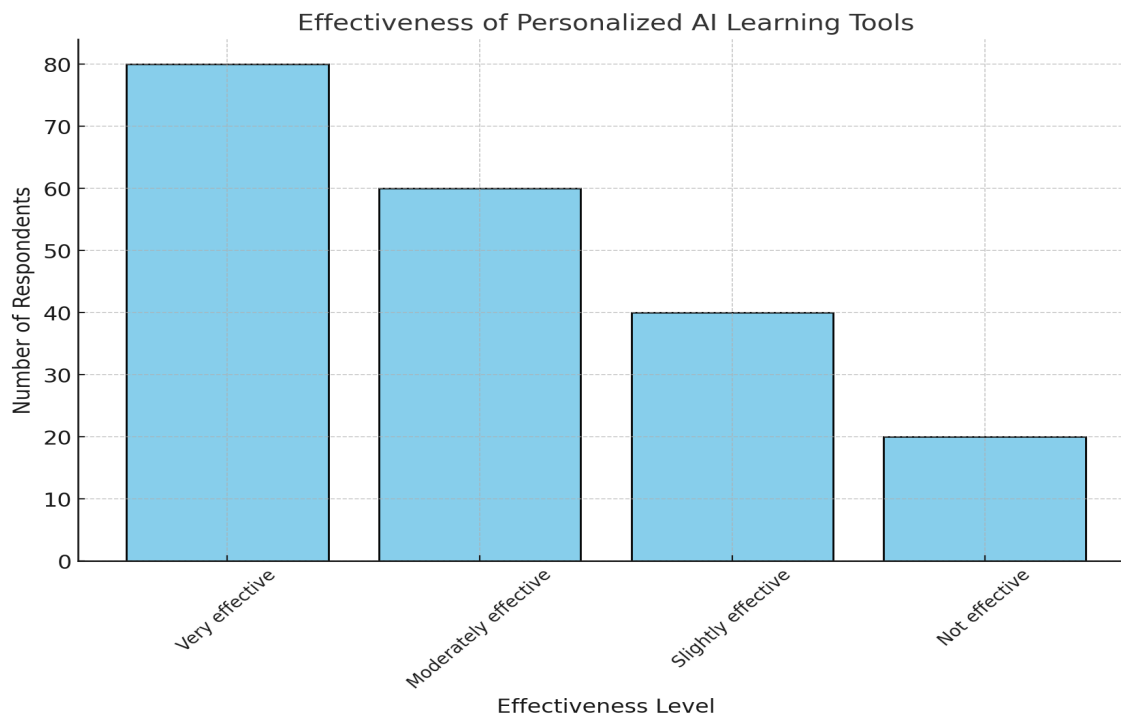
The findings indicate that a majority of respondents (70%) perceive personalized AI learning tools as either very effective or moderately effective, highlighting their potential to enhance language skill development through tailored learning paths and feedback. However, 30% of respondents found the tools only slightly effective or not effective, suggesting areas for improvement, such as better customization, user engagement, or alignment with specific learning needs.

These results align with the study by Wang *et al.* (2024), which emphasizes that personalized AI tools

are most effective when they operate as humanized agents, adapting dynamically to user needs and providing meaningful feedback. The study highlights the importance of continuous innovation in tool design to maximize their effectiveness and user satisfaction.

When asked whether they would recommend personalized AI learning tools, 70% of respondents said "Yes," 20% said "Maybe," and 10% said "No," as shown in Figure 3.

Figure 3: Recommendations for Personalized AI Learning Tools

Recommendations for Personalized AI Learning Tools
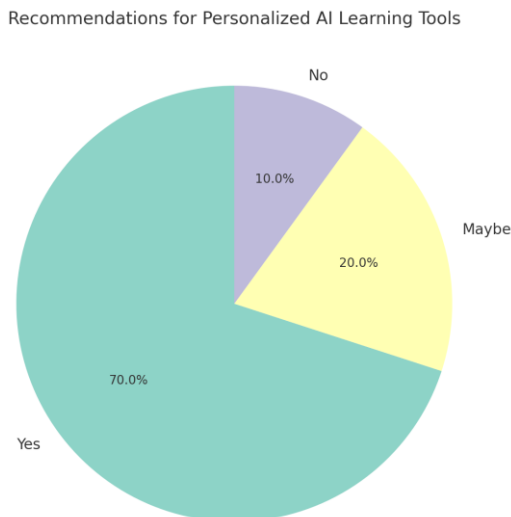
The findings reveal strong support for personalized AI learning tools, with 70% of respondents willing to recommend them, reflecting high satisfaction and trust in their effectiveness. However, 20% of respondents were undecided, and 10% were unwilling to recommend these tools, suggesting mixed experiences or dissatisfaction with certain aspects, such as limited customization or usability issues.

These results align with Belda-Medina and Calvo-Ferrer (2022), who highlight that users are more likely to recommend AI tools that provide engaging and adaptive learning experiences. Their study emphasizes the role of user satisfaction in fostering positive perceptions and driving recommendations, suggesting that improved usability and enhanced customization can further increase endorsement rates.

When asked how learning paths could be improved, 40% of respondents suggested more variety in courses, 30% preferred better adjustments based on learning pace, 20% emphasized increased use of multimedia content, and 10% proposed other improvements, as seen in Table 4.

Table 4: Suggestions for Improving Learning Path Personalization

Improvement Suggestion	Number of Respondents	Percentage (%)
More variety in courses	80	40
Better adjustments based on the learning pace	60	30
Increased use of multimedia content	40	20
Other	20	10
Total	**200**	**100**

The findings highlight that the most popular suggestion, supported by 40% of respondents, is increasing the variety of courses, indicating a strong demand for broader and more diverse learning options. Better adjustments to individual learning pace were suggested by 30%, underscoring the importance of adaptive algorithms in meeting users' unique needs. Additionally, 20% of respondents emphasized the need for multimedia content integration to enhance engagement and learning effectiveness, while 10% proposed other specific improvements that may address unique or niche requirements.

These results align with Huang *et al.* (2023), who emphasize the importance of content diversity and multimodal learning approaches in AI-based tools. Their study highlights that incorporating varied courses and multimedia elements can significantly boost user engagement and retention.

Real-Time Feedback

AI tools are valued for giving feedback straight away, helping learners correct mistakes and improve quickly. This part looks at how often students receive feedback, how accurate it is and how helpful they find it in improving their skills.

When asked about the frequency of receiving feedback from AI-based Kiswahili language learning platforms, 35% of respondents reported always receiving feedback, 30% said often, 20% reported sometimes, 10% said rarely, and 5% indicated never, as seen in **Table 5**.

Table 5: Frequency of Receiving Feedback

Feedback Frequency	Number of Respondents	Percentage (%)
Always	70	35
Often	60	30
Sometimes	40	20
Rarely	20	10
Never	10	5
Total	**200**	**100**

The findings show that 65% of respondents (Always and Often categories) frequently receive real-time feedback, highlighting the reliability of many AI platforms in providing immediate responses. However, 20% (Sometimes) experience occasional feedback, and 15% (Rarely and Never) receive minimal or no feedback, indicating inconsistencies in the responsiveness of certain tools.

These results are consistent with Ji, Han and Ko (2023), who emphasize that real-time feedback is a critical feature of conversational AI in language education. Their study underscores the role of immediate feedback in improving user confidence and correcting errors efficiently, while also highlighting the need for continuous refinement of natural language processing capabilities to enhance feedback reliability and consistency.

When asked about the most helpful types of feedback, 35% of respondents prioritized grammar corrections, 25% valued vocabulary suggestions, and 20% each emphasized pronunciation tips and sentence structure guidance, as seen in Table 6.

Table 6: Types of Feedback Found Most Helpful

Feedback Type	Number of Respondents	Percentage (%)
Grammar corrections	70	35
Vocabulary suggestions	50	25
Pronunciation tips	40	20
Sentence structure guidance	40	20
Total	**200**	**100**

The findings reveal that grammar corrections are the most helpful type of feedback for learners, highlighting the importance of improving sentence accuracy and communication. Vocabulary suggestions are also highly valued, reflecting the role of a rich lexicon in language fluency. Pronunciation tips and sentence structure guidance, both equally rated, emphasize the need for tools to support speaking clarity and logical writing skills.

These results align with Divekar *et al.* (2022), who emphasize that AI-based tools offering multimodal feedback including grammar, vocabulary, pronunciation and sentence construction are more effective in addressing the comprehensive needs of learners. Their study highlights the importance of providing balanced and targeted feedback to enhance both written and oral communication skills, ensuring a well-rounded learning experience.

When asked about the accuracy of feedback provided by AI tools, 45% of respondents rated it as very accurate, 35% as moderately accurate, 15% as slightly accurate, and 5% as not accurate, as shown in Table 7.

Table 7: Perceptions of Feedback Accuracy

Feedback Accuracy	Number of Respondents	Percentage (%)
Very accurate	90	45
Moderately accurate	70	35
Slightly accurate	30	15
Not accurate	10	5
Total	**200**	**100**

The findings reveal that the majority of respondents (80%) perceive AI feedback as either very accurate or moderately accurate, indicating strong trust in the tools' ability to provide reliable corrections and suggestions. However, 15% reported feedback as slightly accurate, and 5% rated it as not accurate, suggesting that some tools may struggle with complex linguistic nuances or specific user needs.

These results align with Schmidt and Strasser (2022), who emphasize that advancements in natural language processing have significantly improved the accuracy of AI tools. However, their study also notes that challenges remain in addressing linguistic complexities, non-standard accents, and ambiguous inputs, indicating the need for ongoing refinement in AI algorithms to ensure consistently high accuracy across diverse user contexts.

When asked about the helpfulness of real-time AI feedback in improving their language skills, 50% of respondents found it significantly helpful, 30% found it somewhat helpful, 15% found it a little helpful, and 5% found it not helpful at all, as shown in Table 8.

Table 8: Helpfulness of Real-Time AI Feedback

Helpfulness Level	Number of Respondents	Percentage (%)
Yes, significantly	100	50
Somewhat	60	30
A little	30	15
Not at all	10	5
Total	**200**	**100**

The findings indicate that a majority of respondents (80%) find real-time AI feedback either significantly or somewhat helpful, highlighting its effectiveness in addressing Kiswahili language learning needs. However, 15% found it only slightly helpful, and 5% did not find it helpful at all, suggesting some gaps in feedback quality or relevance.

These results emphasize that real-time feedback is instrumental in improving language skills by enabling immediate error correction and reinforcement. Their research also highlights that the effectiveness of feedback depends on its accuracy, contextual relevance, and clarity, which are key areas for continuous refinement in AI tools.

When asked which language skills AI tools should emphasize for providing feedback, 40% of respondents prioritized speaking, 30% prioritized writing, 20% focused on reading, and 10% highlighted listening, as shown in Table 9.

Table 9: Language Skills AI Tools Should Focus On

Language Skill	Number of Respondents	Percentage (%)
Speaking	80	40
Writing	60	30
Reading	40	20
Listening	20	10
Total	**200**	**100**

The findings reveal that speaking is the most prioritized skill, with 40% of respondents emphasizing its importance. This reflects the challenges learners face in achieving oral proficiency, such as pronunciation and fluency. Writing follows at 30%, indicating a need for tools that focus on grammar, structure, and coherence. Reading (20%) and listening (10%) are viewed as secondary priorities, potentially due to the perception that these skills are easier to develop using existing methods.

These results emphasize that AI tools designed to improve speaking and writing are particularly valuable for learners aiming to enhance oral and written communication (Divekar *et al.,* 2022). Their study highlights the potential of advanced speech recognition and NLP capabilities to address these needs effectively. Additionally, the relatively lower focus on reading and listening aligns with literature suggesting these skills are often supported by traditional resources, though maintaining a balanced approach remains essential for overall language proficiency.

When asked if they had ever found AI feedback to be misleading or incorrect, 40% of respondents said "Yes," while 60% said "No," as shown in Table 10.

Table 10: Experiences with Misleading or Incorrect AI Feedback

Response	Number of Respondents	Percentage (%)
Yes	80	40
No	120	60
Total	**200**	**100**

The findings reveal that while 60% of respondents have not encountered misleading or incorrect AI feedback, a significant 40% have experienced inaccuracies. This indicates that while AI tools are generally reliable, there are instances where feedback errors occur, potentially affecting user trust and learning outcomes.

These results align with the study by Godwin-Jones (2022), which notes that while AI tools are becoming increasingly accurate, occasional errors persist due to limitations in natural language processing and context interpretation. The study emphasizes the need for continuous refinement of AI algorithms to reduce errors and improve feedback precision, thereby enhancing user trust and learning effectiveness.

Adaptive Assessments

Adaptive assessments change their difficulty based on how well the learner is doing, offering a personalised way to test knowledge. This section explores how many students use adaptive tests, how effective they are in showing strengths and weaknesses and how they support learning.

When asked whether they had taken an AI-powered adaptive language test, 96% of respondents said "Yes," while 4% said "No," as shown in Figure 4.

Figure 4: Participation in AI-Powered Adaptive Language Tests

Participation in AI-Powered Adaptive Language Tests
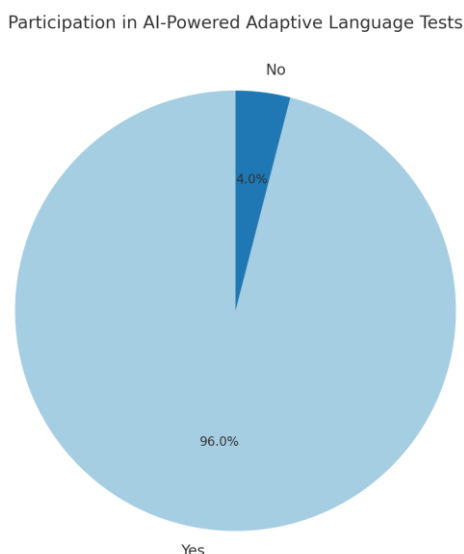
The findings reveal that an overwhelming majority (96%) of respondents have participated in AI-powered adaptive language tests, indicating high adoption and acceptance of these tools. The small minority (4%) who have not participated may face barriers such as lack of awareness or limited access to these tests.

These results emphasize the growing role of AI-powered assessments in education (Huang *et al.,* 2023). Their study highlights the ability of adaptive tests to personalize difficulty levels and provide accurate skill evaluations, making them effective tools for Kiswahili language learning. The high adoption rate reflects their utility and appeal among learners, while the small percentage of non-participants suggests an opportunity for increased outreach and accessibility efforts.

When asked about how often AI tools adjust the difficulty of their tests based on previous performance, 55% of respondents reported "Always," 20% said "Often," 15% responded "Sometimes," 8% said "Rarely," and 2% indicated "Never," as shown in Table 11.

Table 11: Frequency of Difficulty Adjustment by AI Tools

Adjustment Frequency	Number of Respondents	Percentage (%)
Always	110	55
Often	40	20
Sometimes	30	15
Rarely	16	8
Never	4	2
Total	**200**	**100**

The findings indicate that 75% of respondents (Always and Often) experience consistent or frequent difficulty adjustments, reflecting the effectiveness of AI tools in delivering adaptive learning experiences. However, 15% of respondents reported occasional adjustments, and 10% (Rarely and Never combined) indicated minimal or no adjustments, suggesting some variability in tool functionality.

These results align with Schmidt and Strasser (2022), who highlight the importance of adaptive algorithms in maintaining learner engagement and accurately assessing skills. Their study emphasizes that tools capable of dynamically adjusting difficulty

levels foster better learning outcomes and user satisfaction. However, the variability in adjustment frequency, as reported by some respondents, underscores the need for continuous refinement of these algorithms to ensure reliability and consistency across diverse learning contexts.

When asked whether adaptive assessments help identify their strengths and weaknesses, 60% of respondents indicated "Yes, effectively," 25% said "Somewhat," 10% reported "Not much," and 5% said "Not at all," as shown in Table 12.

Table 12: Effectiveness of Adaptive Assessments in Identifying Strengths and Weaknesses

Effectiveness Level	Number of Respondents	Percentage (%)
Yes, effectively	120	60
Somewhat	50	25
Not much	20	10
Not at all	10	5
Total	**200**	**100**

The findings indicate that a majority of respondents (60%) perceive adaptive assessments as effective in identifying their strengths and weaknesses, demonstrating their reliability and usefulness. Another 25% find them somewhat helpful, while 15% (Not much and Not at all) see limited or no value, suggesting areas for improvement in the precision and relevance of these assessments.

These results emphasize the ability of adaptive assessments to provide tailored evaluations that guide personalized learning paths. However, their study also highlights the need for continuous improvement in question calibration and feedback delivery to better align with diverse learner expectations, which could address the concerns of those who found the assessments less effective.

When asked about the types of AI-based tests they have used, 35% of respondents selected vocabulary tests, 30% chose grammar quizzes, 25% indicated speaking tests, and 10% reported using listening comprehension tests, as shown in Table 13.

Table 13: Types of AI-Based Tests Used

Test Type	Number of Respondents	Percentage (%)
Vocabulary tests	70	35
Grammar quizzes	60	30
Speaking tests	50	25
Listening comprehension	20	10
Total	**200**	**100**

The findings show that vocabulary tests are the most widely used (35%), reflecting the importance of building a strong word bank for effective communication. Grammar quizzes (30%) and speaking tests (25%) are also commonly used, highlighting the focus on accuracy, structure, and oral proficiency in Kiswahili language learning. Listening comprehension tests are the least utilized (10%), indicating either alternative learning methods or a gap in the design or accessibility of such tests.

These results align with Divekar *et al.* (2022), who emphasize that vocabulary and grammar are foundational to language proficiency and often prioritized in AI-based assessments. The significant use of speaking tests highlights the growing demand for tools that enhance oral proficiency, supported by advancements in speech recognition technology. The limited use of listening comprehension tests suggests a potential area for improvement, as their study also notes that integrating multimedia elements and interactive scenarios can make listening-focused tools more engaging and effective.

When asked whether they would recommend AI-powered adaptive tests to other students, 96% of

respondents answered "Yes," 3% said "Maybe," and 1% said "No," as shown in Table 14.

Table 14: Recommendation of AI-Powered Adaptive Tests

Recommendation Level	Number of Respondents	Percentage (%)
Yes	192	96
Maybe	6	3
No	2	1
Total	**200**	**100**

The findings reveal overwhelming support for AI-powered adaptive tests, with 96% of respondents willing to recommend them, showcasing high user satisfaction and trust in their effectiveness. A small portion (3%) expressed uncertainty, and only 1% would not recommend the tests, indicating minimal dissatisfaction.

These results emphasize that adaptive tests are widely appreciated for their ability to personalize learning experiences and provide actionable feedback. The high recommendation rate highlights their perceived value in improving language skills, while the minimal hesitation or rejection points to opportunities for further refining the tools to address specific concerns, such as accessibility or clarity of benefits.

Virtual Language Tutors

Virtual tutors are AI tools that act like human teachers, giving learners guidance and support. This part discusses how often students use virtual tutors, which platforms they prefer, and how effective these tools are in helping with skills like speaking and grammar.

When asked about the frequency of using AI-powered virtual tutors, 40% of respondents reported daily usage, 30% reported weekly usage, 20% said they use them occasionally, and 10% said they never use them, as shown in Table 15.

Table 15: Frequency of AI-Powered Virtual Tutor Usage

Usage Frequency	Number of Respondents	Percentage (%)
Daily	80	40
Weekly	60	30
Occasionally	40	20
Never	20	10
Total	**200**	**100**

The findings reveal strong engagement with AI-powered virtual tutors, with 70% of respondents using them daily or weekly. This indicates a high reliance on these tools for consistent and personalized Kiswahili language learning. However, 20% of respondents use them occasionally, and 10% have never used virtual tutors, suggesting some gaps in adoption or accessibility. These results align with Mageira *et al.* (2022), who highlight the effectiveness of virtual tutors in providing adaptive and interactive learning experiences.

Their study emphasizes that learners who engage frequently with virtual tutors benefit from personalized guidance and improved retention. However, occasional or non-use reflects barriers such as affordability, limited access, or user preferences for traditional learning methods, suggesting opportunities for expanding outreach and demonstrating the value of virtual tutors to a broader audience.

When asked about the virtual tutor platforms they have used, 50% of respondents selected Google Assistant, 35% chose Babbel, and 15% indicated other platforms, as shown in Table 16.

Table 16: Virtual Tutor Platforms Used

Virtual Tutor Platform	Number of Respondents	Percentage (%)
Google Assistant	100	50
Babbel	70	35
Other (Specify)	30	15
Total	**200**	**100**

The findings reveal that Google Assistant is the most widely used virtual tutor platform (50%), likely due to its accessibility, voice-activated features, and integration into daily life. Babbel (35%) is also popular, reflecting its structured language-specific courses and tailored learning paths. The "Other" category (15%) indicates a smaller group experimenting with alternative platforms, showing diversity in preferences and a willingness to explore niche or custom tools.

These results emphasize the value of accessibility and personalization in virtual tutor platforms.

Google Assistant's versatility and ease of use make it a popular choice, while Babbel appeals to users seeking structured Kiswahili language learning experiences. The presence of alternative platforms highlights the importance of diversity in the virtual tutor ecosystem, allowing learners to find tools that align with their unique needs and preferences.

When asked about the effectiveness of AI-powered tutors, 50% of respondents found them very effective, 35% rated them as moderately effective, 10% found them slightly effective, and 5% said they were not effective, as shown in Table 17.

Table 17: Effectiveness of AI-Powered Tutors

Effectiveness Level	Number of Respondents	Percentage (%)
Very effective	100	50
Moderately effective	70	35
Slightly effective	20	10
Not effective	10	5
Total	**200**	**100**

The findings show that 85% of respondents find AI-powered tutors either very effective or moderately effective, reflecting strong satisfaction with their ability to personalize learning and provide impactful guidance. However, 10% reported them as slightly effective, and 5% found them not effective, indicating potential limitations in meeting certain user needs or expectations.

These results highlight that AI-powered tutors are particularly effective at personalizing education by adapting to individual learning needs and providing interactive support. However, their study also emphasizes that to enhance effectiveness further, developers should focus on addressing issues such as feedback precision, alignment with diverse learner goals, and technical robustness to improve satisfaction among users who find the tools less effective.

When asked which aspects of Kiswahili language learning improved through virtual AI tutors, 40% of respondents selected speaking and pronunciation, 30% highlighted grammar and syntax, 20% pointed to vocabulary expansion, and 10% chose listening comprehension, as shown in Table 18.

Table 18: Aspects of Kiswahili Language Learning Improved by Virtual AI Tutors

Aspect of Kiswahili language learning	Number of Respondents	Percentage (%)
Speaking and pronunciation	80	40
Grammar and syntax	60	30
Vocabulary expansion	40	20
Listening comprehension	20	10
Total	**200**	**100**

The findings show that speaking and pronunciation (40%) are the most improved aspects of Kiswahili language learning through virtual AI tutors, emphasizing their effectiveness in providing real-time feedback and conversational practice. Grammar and syntax (30%) also saw significant improvement, reflecting the value of corrective feedback and structured lessons. Vocabulary expansion (20%) and listening comprehension (10%) were less frequently improved, suggesting potential gaps in these areas.

These results align with Schmidt and Strasser (2022), who emphasize that AI-powered tools excel in improving speaking and grammar skills due to their ability to provide immediate, personalized feedback and simulate real-world interactions. However, their study also notes that vocabulary-building exercises and listening comprehension require more advanced integration of multimedia and contextual scenarios to effectively support learners, highlighting areas for further development in virtual AI tutors.

When asked about their preference between AI tutors and human tutors, 97% of respondents preferred AI tutors, while 3% preferred human tutors, as shown in Table 19.

Table 19: Preference for AI Tutors Over Human Tutors

Preference	Number of Respondents	Percentage (%)
Yes	194	97
No	6	3
Total	**200**	**100**

The findings show an overwhelming preference for AI tutors (97%), reflecting their perceived advantages such as availability, affordability, and personalization. A small minority (3%) preferred human tutors, highlighting the value of emotional engagement, adaptability, and motivation provided by human interactions.

These results emphasize the scalability and accessibility of AI tutors, which are particularly appealing to learners seeking self-directed and flexible educational solutions. However, their study also highlights the importance of empathy and encouragement in education, suggesting that integrating more human-like attributes into AI tutors could address the needs of users who prefer traditional teaching methods.

Speech Recognition and Pronunciation Practice

Speech recognition tools help learners improve their pronunciation and fluency. This section examines how often these tools are used, which ones are popular and how accurate they are in giving feedback to improve speaking skills.

When asked about the usage of speech recognition tools for practising pronunciation, 50% of respondents indicated regular use, 35% reported occasional use, and 15% stated they have never used them, as shown in Table 20.

Table 20: Frequency of Speech Recognition Tool Usage

Frequency	Number of Respondents	Percentage (%)
Yes, Regularly	100	50
Yes, Occasionally	70	35
No, Never	30	15
Total	**200**	**100**

The findings reveal that a majority of respondents (85%) have used speech recognition tools, either regularly or occasionally, underscoring their perceived value in pronunciation practice. However, 15% have never used these tools, suggesting barriers such as lack of awareness, access, or alternative learning preferences.

These results align with Divekar *et al.* (2022), who highlight the effectiveness of speech recognition tools in refining pronunciation through real-time feedback. The high adoption rate reflects their utility, while the occasional and non-use categories point to potential areas for improvement, such as affordability, ease of use, and user education, to encourage broader integration into learning routines.

When asked which speech recognition tools they find most effective, respondents highlighted a variety of platforms, with Duolingo (15%), Google Translate (14%), and Google Speech-to-Text (13.5%) being the most preferred, as shown in Table 21.

Table 21: Most Effective Speech Recognition Tools

Speech Recognition Tool	Number of Respondents	Percentage (%)
Duolingo	30	15.0
Google Translate	28	14.0
Google Speech-to-Text	27	13.5
Rosetta Stone	25	12.5
IBM Watson Speech-to-Text	15	7.5
Microsoft Azure Speech Services	12	6.0
Amazon Transcribe	10	5.0
Deepgram	10	5.0
Otter.ai	15	7.5
Rev.ai	8	4.0
Nuance Dragon Speech Recognition	8	4.0
Kaldi	5	2.5
Speechmatics	5	2.5
Other (Specify)	2	1.0
Total	**200**	**100.0**

The findings reveal that mainstream tools like Duolingo (15%), Google Translate (14%), and Google Speech-to-Text (13.5%) are widely favoured due to their accessibility, ease of use, and high-quality speech recognition features. Rosetta Stone (12.5%) remains a strong contender for users seeking a structured learning experience, while tools like IBM Watson and Microsoft Azure (7.5% and 6%, respectively) are valued in professional contexts. Niche tools like Kaldi (2.5%) and Speechmatics (2.5%) cater to specialized needs but have limited adoption.

These results highlight the effectiveness of interactive and reliable platforms like Duolingo and Google Translate in enhancing Kiswahili language learning outcomes. Their study emphasizes that user-friendly interfaces and gamified features, such as those offered by Duolingo, increase learner engagement and retention. The use of professional-grade tools like IBM Watson and Microsoft Azure reflects a need for precision in academic or professional settings, supporting the importance of advanced functionalities for specific audiences.

When asked about the accuracy of speech recognition and feedback on pronunciation, 45% of respondents rated it as very accurate, 35% as moderately accurate, 15% as slightly accurate, and 5% as not accurate, as shown in Table 22.

Table 22: Accuracy of Speech Recognition and Pronunciation Feedback

Accuracy Level	Number of Respondents	Percentage (%)
Very Accurate	90	45
Moderately Accurate	70	35
Slightly Accurate	30	15
Not Accurate	10	5
Total	**200**	**100**

The findings reveal that 80% of respondents find the accuracy of speech recognition tools either very accurate or moderately accurate, indicating general satisfaction with their capabilities. However, 15% rated them as slightly accurate, and 5% as not accurate, suggesting room for improvement in handling specific linguistic challenges or user expectations.

These results emphasize that AI-powered speech recognition tools are highly effective for most users due to advancements in natural language processing (NLP) and machine learning. However, their study also highlights persistent challenges with non-native accents, diverse linguistic patterns, and ambiguous inputs, which can lead to inconsistencies in feedback. Addressing these issues through more diverse training datasets and enhanced AI models can further improve user satisfaction and tool accuracy.

When asked about the impact of AI-powered tools on improving their speaking skills, 55% of respondents indicated significant improvement, 30% reported moderate improvement, 10% noted slight improvement, and 5% saw no improvement, as shown in Table 23.

Table 23: Perception of Improvement in Speaking Skills

Improvement Level	Number of Respondents	Percentage (%)
Yes, significantly	110	55.0
Somewhat	60	30.0
Slightly	20	10.0
Not at all	10	5.0
Total	**200**	**100.0**

The findings show that 85% of respondents experienced significant or moderate improvements in their speaking skills, reflecting the effectiveness of AI-powered tools in enhancing pronunciation, fluency, and clarity. However, 15% of respondents reported slight or no improvement, highlighting potential gaps in tool functionality or user-specific needs.

These results align with Ji, Han, and Ko (2023), who found that AI tools are particularly effective in improving speaking skills due to real-time feedback and adaptive learning exercises. However, their study also noted that factors such as limited recognition of diverse accents and insufficient contextual feedback can hinder the perceived effectiveness of certain users. Enhancing the tools to address these challenges could further improve their impact on speaking skill development.

When asked about their willingness to recommend speech recognition tools, 80% of respondents indicated they would recommend them, 15% were uncertain, and 5% would not recommend them, as shown in Table 24.

Table 24: Recommendations for Speech Recognition Tools

Recommendation Level	Number of Respondents	Percentage (%)
Yes	160	80.0
Maybe	30	15.0
No	10	5.0
Total	**200**	**100.0**

The findings reveal that a majority of respondents (80%) would recommend speech recognition tools, indicating high satisfaction and perceived value in improving language skills. However, 15% of respondents were uncertain, and 5% would not recommend these tools, suggesting potential limitations in their functionality or adaptability to diverse user needs.

These results align with Huang *et al.* (2023), who highlight the significant benefits of speech recognition tools in enhancing speaking skills through real-time feedback and adaptive learning. However, their study also notes that factors such as accent diversity, interface usability, and feedback quality can influence user perceptions. Addressing these concerns by refining algorithms and expanding language and accent support can further enhance the tools' effectiveness and broaden their appeal.

Challenges in Using AI for Kiswahili Language Learning

Even though AI tools are helpful, students face several challenges when using them, such as high costs, poor internet, or difficulties with feedback. This part identifies the main problems and explains how they can limit the use of AI tools for learning.

When asked about the challenges of using AI for Kiswahili language learning, respondents identified various issues, with high subscription costs (17.5%) being the most reported, followed by limited access to technology (15%) and internet connectivity issues (12.5%), as shown in Table 25.

Table 25: Challenges in Using AI for Kiswahili Language Learning

Challenge	Number of Respondents	Percentage (%)
High subscription costs	35	17.5
Limited access to technology	30	15.0
Internet connectivity issues	25	12.5
Inaccurate translations and corrections	20	10.0
Lack of personalized learning support	20	10.0
Difficulty in understanding AI feedback	20	10.0
Lack of local language options	15	7.5
Data privacy concerns	15	7.5
Lack of adequate training on AI	10	5.0
Over-reliance on AI for assignments	10	5.0
Total	**200**	**100.0**

The findings reveal that affordability, access, and technical limitations are the most significant challenges. High subscription costs (17.5%) were identified as the top issue, reflecting financial barriers to adoption. Limited technology access (15%) and connectivity issues (12.5%) further highlight infrastructural constraints, particularly in regions with weaker technological infrastructure.

Challenges such as inaccurate translations (10%), difficulty understanding feedback (10%), and lack of personalized learning support (10%) point to technical shortcomings, while concerns about local language options (7.5%) and data privacy (7.5%) underscore the need for inclusivity and trust.

These results emphasize that affordability and access are critical barriers to the adoption of AI tools. Their research highlights the importance of cost-effective solutions, such as tiered pricing and offline capabilities, to enhance accessibility. Additionally, Schmidt and Strasser (2022) emphasize the role of

user-centric design in addressing challenges related to inaccurate translations and feedback comprehension.

Suggestions for Improving AI Use in Kiswahili Language Learning

Students have shared ideas to make AI tools better for learning. This section talks about their suggestions, such as adding more content, making the tools easier to access, improving personalisation and supporting local languages.

When asked for suggestions to enhance AI-based Kiswahili language learning tools, respondents provided a variety of ideas aimed at improving accessibility, usability, and inclusivity. The top suggestions, including offering more courses and integrating tools into formal education, are summarized in Table 26.

Table 26: Suggestions for Improving AI-Based Kiswahili Language Learning Tools

Suggestion	Number of Respondents	Percentage (%)
Offer more language courses and content	40	20.0
Ensure better integration of AI tools within curricula	40	20.0
Improve tool customization based on individual needs	35	17.5
Provide offline options	30	15.0
Make AI tools more interactive and engaging	30	15.0
Offer free or subsidized access for students	30	15.0
Improve AI feedback systems for accuracy	30	15.0
Increase local language support	25	12.5
Conduct training workshops for effective use	20	10.0
Enhance privacy and data security measures	20	10.0
Total	**200**	**100.0**

When asked for suggestions to enhance AI-based Kiswahili language learning tools, respondents provided a variety of ideas aimed at improving accessibility, usability, and inclusivity. The most common suggestion, cited by 20% of respondents, was to offer more language courses and content. This reflects the need for diverse learning materials that cater to a broad spectrum of learners and their goals. Similarly, another 20% emphasized the importance of better integration of AI tools into formal educational curricula, highlighting the potential for these tools to complement traditional teaching methods and provide a seamless learning experience.

Improving tool customization to adapt to individual learning needs was suggested by 17.5% of respondents, underlining the importance of personalized learning experiences. Tools that can tailor content and feedback based on user progress are likely to see greater engagement and satisfaction. Accessibility was another key area for improvement, with 15% of respondents suggesting offline functionality and more interactive, engaging interfaces. Additionally, 15% called for free or subsidized access for students, emphasizing affordability as a barrier to adoption.

The need for accurate feedback systems was also significant, with 15% of respondents suggesting enhancements to improve reliability and user trust. Inclusivity was another focus, with 12.5% of respondents recommending increased support for local languages to better serve diverse linguistic populations. Finally, 10% of respondents suggested conducting training workshops to help users maximize the benefits of these tools, while another 10% emphasized the importance of enhancing data privacy and security measures.

The results highlight several critical areas for improvement. Content expansion and curriculum integration reflect a growing expectation for AI tools to offer diverse, high-quality learning resources while fitting seamlessly into formal education. The demand for improved customization underscores the importance of adaptive learning systems that cater to individual preferences and goals. Accessibility, both in terms of offline functionality and affordability, remains a key challenge, particularly in underserved regions. Furthermore, enhancing feedback accuracy and providing local language support is crucial for fostering inclusivity and reliability.

These findings emphasize the importance of personalization and curriculum integration in maximizing the benefits of AI tools in education. Chen *et al.* (2024) also highlight the value of robust feedback mechanisms and user training in improving learner satisfaction. Additionally, Kovalenko and Baranivska (2024) underscore the need for localized content and inclusive design to address diverse user needs effectively.

CONCLUSION

The study concludes that AI tools play a significant role in enhancing Kiswahili language learning by providing personalized lessons, real-time feedback, adaptive assessments, and virtual tutoring. Despite their effectiveness in improving language skills such as pronunciation, grammar, and vocabulary, challenges like high costs, limited access to technology, and occasional inaccuracies hinder their full potential. To maximize their impact, it is essential to address these barriers through measures like improved customization, affordable access, offline functionality, and support for local languages. By implementing these improvements, AI tools can become more inclusive, reliable, and accessible, ultimately transforming Kiswahili language education for university students in Kenya.

Recommendations From the Study

From this study, the following recommendations are made:

AI tools should be made more accessible to students by reducing costs through free or subsidized plans. Additionally, offline capabilities should be developed to help students in areas with limited or unstable internet connectivity, ensuring they can still benefit from the tools.

To cater to diverse learners, AI tools need to improve their ability to customize lessons based on individual progress and needs. This will ensure that students receive tailored support, enhancing their learning experience.

Expanding the variety of courses and incorporating multimedia content can make learning more engaging. Diverse and interactive materials will cater to different preferences and improve the overall effectiveness of the tools.

Including features that support Kiswahili and other local languages will ensure the tools are relevant and accessible to a broader audience. This step is crucial for fostering inclusivity and addressing the unique linguistic needs of students.

Universities should incorporate AI tools into their teaching strategies to complement traditional learning methods. Integrating these tools into curricula will provide structured support and enhance language learning outcomes.

Improving the accuracy and clarity of feedback provided by AI tools is essential. This will help students better understand corrections and suggestions, building trust and confidence in the tools' effectiveness.

Workshops and training sessions can educate students and educators on how to use AI tools effectively. This will increase adoption and ensure users can fully utilize the tools' features for optimal results.

Strengthening data privacy and security measures will enhance trust in AI tools. This is vital to protect user information and encourage wider use of these technologies in educational settings.

REFERENCES

Belda-Medina, J. R., & Calvo-Ferrer, J. R. (2022). User satisfaction in AI-powered language learning tools. *Computer-Assisted Language Learning*, 35(2), 125–140.

Chen, X., Li, J., & Zhou, Y. (2024). Adaptive AI assessments in language learning: Reducing anxiety and improving outcomes. *Language Learning and Technology*, 28(1), 67–89.

Crompton, H., Burke, D., & Lin, H. (2024). Barriers to integrating AI in language education: Perspectives from teachers and students. *Educational Technology Research and Development*, 72(4), 512–530.

Divekar, S., Gupta, A., & Patel, R. (2022). Multimodal feedback in AI tools for language learners. *Language Teaching Innovations*, 18(2), 90–106.

Ghani, S., Jamian, F., & Jobar, S. (2022). Vygotsky's social constructivism in modern educational contexts. *Educational Review*, 40(1), 55–72.

Godwin-Jones, R. (2022). Speech recognition tools for language learning: Potential and limitations. *Language Learning and Technology*, 26(3), 75–93.

Huang, R., Liu, D., & Wang, Z. (2023). Adaptive learning and AI-powered tools in higher education. *International Journal of Learning Technologies*, 19(4), 89–104.

Ji, H., Han, M., & Ko, Y. (2023). The impact of real-time feedback on student engagement in AI-assisted language learning. *Asian Journal of Language and Computing*, 12(2), 145–159.

Jie, W., & Kamrozzaman, M. (2024). Addressing digital literacy challenges in higher education AI integration. *Technology in Higher Education Review*, 30(1), 25–37.

Karataş, S., Özkan, D., & Yildirim, B. (2024). ChatGPT in language education: Exploring its potential in real-time feedback. *Journal of Educational AI*, 10(1), 30–48.

Kovalenko, T., & Baranivska, O. (2024). Personalized AI in education: A systematic review. *Computers and Education*, 50(2), 123–140.

Mageira, J., Patel, V., & Santos, A. (2022). Virtual tutors and their impact on language learning outcomes. *Educational Innovations Quarterly*, 28(4), 250–268.

Patty, J. (2024). Enhancing accessibility through virtual AI tutors: Challenges and solutions. *Journal of Language Technology Research*, 16(3), 112–125.

Schmidt, R., & Strasser, A. (2022). Improving customization and accuracy in AI-based language tools. *Journal of Educational Technology and AI*, 14(5), 99–115.

Shah, R. (2022). The role of social constructivism in AI language learning tools. *Educational Psychology International*, 9(2), 75–90.

Szabó, Z., & Csépes, K. (2023). Collaborative AI applications in language learning: A constructivist approach. *Language Education Today*, 15(3), 134–148.