

Effectiveness of AI on Instruction of English Listening and Speaking among Learners with Autism in Nakuru East Sub-county

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Abstract: *The purpose of this study was to analyse the effectiveness of AI on instruction of English Listening and Speaking among learners with autism in Nakuru East Sub-county and to evaluate the challenges of using AI on instruction of English Listening and Speaking for learners with autism in Nakuru East Sub-county. The study was guided by the Usage-Based Theory of Language Acquisition, proposed by Michael Tomasello. It employed the quasi experimental mixed-methods research design. The target population of the study was 200 learners with autism in 6 special needs schools in Nakuru, from which a sample of 133 learners was selected through simple random sampling. Additionally, 6 teachers were selected for interviews. Data was collected using a language instruction test for learners and an interview guide for the teachers. Quantitative data was analyzed using descriptive and inferential statistics, while qualitative data from semi-structured interviews with teachers was thematically analyzed. Learners' post-intervention language performance was not strongly linked to their initial ability levels ($B = 0.007$, $p = .923$). Learners exposed to AI tools demonstrated stronger gains compared to those taught using traditional methods. The experimental group consistently outperformed the control group even after accounting for initial differences. Learners in the AI group had more frequent transitions from incorrect to correct responses. The study concludes that AI-supported language instruction is more effective than traditional teaching methods. Teacher training institutions and the Teachers Service Commission should enhance CPD initiatives that are oriented towards integrating AI in the teaching of languages.*

Keywords: artificial intelligence, effectiveness, language instruction, learners with autism, Nakuru east sub-county

INTRODUCTION

Autism Spectrum Disorder (autism) has unique challenges in language instruction and communication, including difficulties in social interaction, restricted linguistic expressions and repetitive communication patterns (El-Shemy, 2022). Such variability in language abilities among autistic learners calls for individualized approaches to language instruction and acquisition (Taylor, 2022). In applied linguistics and language acquisition, recent advances in Artificial Intelligence (AI) have introduced transformative tools that support tailored language learning experiences. AI-powered adaptive learning environments indeed offer a balanced structure of activities for autistic learners, enabling them to practice language in a flexible manner (Elhadi, 2023). The research findings in applied linguistics indicate that language learning supported by robots and interaction via virtual reality (VR) can effectively improve the learners' communication skills and lower their anxiety level providing them controlled yet socially engaging linguistic settings (Gautam, 2024; Tolman, 2023). Moreover, AI-based data analytics help pinpoint speakers' distinctive communication habits, which in turn facilitates the provision of language teaching methodologies that are tailored to individual linguistic requirements (Shamsuddinova et al., 2024). These developments exemplify the educational system's move towards dynamic and responsive language teaching methods.

AI resources such as Augmented Reality (AR), adaptive learning programs and generative AI models have transformed the engagement of autistic learners with language in schools (Grecu, 2023). Utilizing such devices can elevate learners' proficiency in communication as they enable the alignment of pedagogical material with the learners' cognitive and linguistic capabilities, which conduce the better understanding, retention and application of language. Besides, generative AI is also readily available to produce custom linguistic materials and interactive communicative scenarios that can serve the learning style diversity and simultaneously provide language practice with a high degree of relevance (Chen et al., 2020). Most importantly, the intelligent assessment instruments offer the learners' linguistic performance a source of instant feedback whereby challenges can be spotted and targeted help can be guided. These AI-powered language teaching solutions thus create a fertile ground for the realization of the goals of the field of applied linguistics.

Artificial Intelligence is important in examining data related to communicative behaviors, which include speech patterns, discourse structures and interactional cues of learners with autism (Anis, 2023). These examinations are instrumental in pinpointing the linguistic markers that disclose the differences in language processing and use, thus leading to the tailoring of more suitable teaching methods (Shafiee, 2024). In addition to this, AI-driven solutions facilitate the language development monitoring process through the provision of learning interventions that correspond to followers' changing communicative needs over time (Salao, 2022). The said instances, however, are not limited within the four walls of a classroom as they offer an abundance of information to parents and teachers about the students' language progress and trammled areas, besides the support they can provide (Rogti, 2021). In a nutshell, AI not only upgrades the comprehension of language acquisition in autism but also facilitates building of inclusive, supportive pedagogical practices in linguistics that cater to the needs of the learners.

Learners with autism face significant challenges in communication and social interaction due to difficulties in expressing themselves, understanding others, or adhering to social communication norms. These challenges vary among individuals and can change over time, affecting different aspects of speech, language and social interaction. Learners with autism may struggle with producing or interpreting expressive and receptive language, articulating speech sounds, or understanding verbal and non-verbal communication. Additionally, these learners often have challenges grasping age-appropriate social convention such as turn-taking in conversations or appropriate physical contact.

Conventional ways of teaching a language might not be able to cater to the varied requirements of such learners, thereby resulting in their limited growth and lack of involvement (Klein, 2024). The question of how the use of AI in the language instruction of autistic learners effects the effectiveness of the teaching method is hardly addressed in existing literature. Besides that, the views of the teachers, who are the users and facilitators of such technology, constitute a very small fraction of research. This study's question is : What is the effectiveness of AI on language instruction among learners with autism in Nakuru East Sub-county?

Theoretical framework

This research is guided by the usage-based theory of language acquisition. The theory was introduced by Michael Tomasello (2003). The usage-based theory posits that language configuration arises from usage, enabling learners to use cognitive skills to understand adult intentions and recognize patterns, forming abstract linguistic categories (Ghalebi & Sadighi, 2015). Bavin (2009) supports this view, emphasizing that language acquisition relies on general cognitive processes, posing challenges to nativist theories. Tomasello (2003) identifies four key operations for language development: Intention-Reading, Cultural Learning, Schematization and Functionally Based Distributional Analysis. The usage-based view of language communication can be categorised into two rules: meaning is use and structure comes from use. The first rule explains that the linguistic conventions play social roles whereas the second one suggests that constructions created based on meaning derive from individual language use (Gross, 2005). A usage-based theory was suggested by Tomasello (2003) according to which the learner uses intention-reading to determine speakers' intentions and pattern-finding to identify the linguistic schemes, combining functional and structural aspects of language development (Ellis, 2019). The usage-based theory of language acquisition emphasizes that language develops through repeated use and interaction (Tomasello, 2003). AI provides consistent language practice for learners with autism, enhancing exposure and interaction crucial for language learning (Toppelberg & Collins, 2004). This theory helps identify challenges that could impede usage and interaction, affecting language acquisition success.

METHODOLOGY

Research Design

A research design is a structured method used by researchers during a scientific inquiry (Abutabenjeh & Jaradat, 2018). This study used a quasi-experimental mixed-methods research design, which

systematically described and analyzed the characteristics, patterns and themes related to the research problem. The study used non-numerical information that included opinions, experiences and narratives to analyze the integration of AI on language instruction of learners with autism.

Study Area

The study was conducted in Nakuru East Sub-county. The county spans an area of approximately 7,500 square kilometers and serves as a hub for economic, cultural and social activities. The county is also home to educational institutions ranging from primary schools to universities, supporting the development of skilled professionals and learners.

Study Population

The target population of the study were 200, grade 10 learners with autism in 6 special needs schools in Nakuru East sub county.

Sampling Procedure and Sample Size

Mugenda and Mugenda (2003) emphasize that selecting the appropriate sample size from the available population is important to achieve research objectives. Yamane (1967) formula was used to determine the sample size (n) , as the population (N) is known, with e as the error margin. Thus,

$$n = \frac{N}{1 + N(e)^2}$$

$$n=200/1+200 (0.05)^2$$

Therefore, the sample size was 133. The study used simple random sampling to select 133 learners in the 6 schools in Nakuru East Sub-County. A teacher in each of the schools was selected for interviews.

Data Collection Techniques

The study employed mixed methods to collect comprehensive data on the integration of AI in the instruction of English listening and speaking for learners with autism in Nakuru East Sub-County. Data collection involved the use of a language instruction test and an interview guide. Two types of language instruction tools were administered, which were given to both the experimental and control groups before any intervention, allowing the researcher to determine the equivalence of their baseline proficiency levels. After the intervention, the post-test evaluated improvements in proficiency and enabled a comparison between the effectiveness of AI-based language instruction and traditional language learning methods. A panel of five teachers of English, selected randomly from participating schools, was trained on integrating AI into English language listening and speaking instruction for autistic learners. Subsequently, these teachers designed and moderated the test items. A table of specifications guided the construction of the language instruction tests to achieve a balanced evaluation of knowledge and skills (Khan, Hussain &

Malik, 2021). An interview guide was used to collect qualitative data from teachers, focusing on the effectiveness and challenges of using AI in language instruction for autistic learners.

Reliability and Validity

Piloting for the study was done among 14 autistic learners in a special needs school in Kiambu County; with 7 learners in the control and 7 in the experimental group. This agrees with Connelly's (2008) suggestion that the pilot sample size should be 10% of the main study sample size. The participants were briefed on the objectives of the study and participants completed the provided language instructions independently. Piloting determined the time taken to complete the language instructions and the participants' comprehension of the statements. Any challenges with the wording, clarity and the legibility of the questions due to the pilot participants was noted.

Mohajan (2017) notes that reliability is the capability of an instrument to consistently measure the intended variables. Split half method verified the consistency of results over time and internal consistency determined the relationship of the questions in the tool. Cronbach's Alpha coefficient was the measure of reliability, with a value of 0.7 or higher being quite satisfactory, (Segal & Coolidge, 2018). The validity of an instrument was evaluated based on construct, content and criterion validity (Taherdoost, 2016). Construct validity identified the extent to which the tools measured the right concepts. Content validity ensured that the study was in line with the research objectives. Criterion validity was used to assess the degree of correlation between the pilot results and the expected outcomes.

Data Analysis and Presentation

Quantitative data was analyzed through descriptive statistics to present baseline and post-intervention performance and inferential statistics, such as paired sample t-tests to evaluate within-group changes and independent t-tests to compare between-group results. Analysis of Co-variance was used to account for initial differences. Thematic analysis was used to analyse qualitative data.

Ethical Considerations

A letter from the university ethics committee was obtained, followed by a research permit from NACOSTI. Respondents were informed about the study's purpose and objectives before providing consent voluntarily. There was no coercion and data were collected anonymously. Collected data was securely stored, with soft data in password-protected files. Parental consent or legal guardian approval was sought, along with learner assent, ensuring privacy and confidentiality through data anonymization.

RESULTS

Response Rate

The study provided a language instruction test to 133 learners in the 6 schools in Nakuru East sub county , out of which 104 were completed and returned. This is a response rate of 78%. The response rate is as illustrated in Table 1:-

Table 1: Response rate

Category	Sample	Responses	Response rate
Learners	133	104	78%
Total	133	104	78%

Paired Samples t-Test Within the Group

The study assessed within-group changes from pre-test to post-test scores and comparative performance between the experimental and control groups. The paired samples correlation between pre-total and post total was examined to assess the relationship between learners' baseline and post-intervention language performance. The results show a weak positive correlation ($r = 0.092$, $n = 104$), thus, an insignificant linear association between pre-test and post-test scores. The correlation was statistically significant ($p = 0.005$), thus, despite the weak strength of the relationship, the association was unlikely to have occurred by chance. Thus, post-test performance was influenced by factors other than baseline ability, including AI integration. This is shown in Table 2

Table 2 : Paired Samples t-Test Within the Group

		N	Correlation	Sig.
Pair 1	Pre-total & post-total	104	0.092	0.005

Independent Samples t-Test Performance scores

Moreover, the independent samples t-test was employed in testing the improvement made in performance between the experimental and control groups. It was aimed at checking whether the difference between the pre-test and post-test performance of the participants in each of the groups was statistically significant. It was intended to find out if the AI-integration in instruction led to a more effective learning than that done through the traditional teaching method.

Since Levene's test for equality of variances was not significant ($F = 3.402$, $p = 0.068$), the assumption of equal variances was found to be true, hence the appropriateness of the results under the "Equal variances assumed". In the result, the differences in gain scores between the two groups was statistically significant $t(102) = 6.475$, $p < 0.001$. This was because the mean difference was 2.865, implying that the experimental group performed better than the control group by 2.87 points in the improvement level. In addition, the confidence interval of the difference did not include zero. This is illustrated in Table 3

Table 3 : Independent Samples t-Test Performance Scores

	Levene's Test for Equality of Variances		t-test for Equality of Means		Sig. (2- tailed)	Mean Difference
	F	Sig.	t	df		
Equal variances assumed	3.402	0.068	6.475	102	0.000	2.86538
Equal variances not assumed			6.475	95.333	0.000	2.86538

Analysis of Covariance (ANCOVA)

The study employed Analysis of Covariance (ANCOVA) to evaluate the effect of the AI intervention on learners' language performance. This controlled for any initial differences in pre-test scores and isolated the effect of instructional treatment on post-test outcomes. Tests of Between-Subjects effects results indicate that the model was statistically significant, $F(2, 101) = 82.430$, $p < .001$, explaining a significant proportion of variance in post-test scores ($R^2 = .620$, Adjusted $R^2 = .613$). Thus, 62% of the variation in

learners' post-test performance was accounted for by pre-test scores and group membership. The effect of pre-total was not statistically significant, $F(1, 101) = 0.009$, $p = .923$, with an insignificant effect size (partial $\eta^2 = .000$). Thus, baseline performance did not significantly predict post-test outcomes after controlling for the intervention. On the other hand, group had a strong and statistically significant effect on post-test scores, $F(1, 101) = 162.629$, $p < .001$, with a large effect size (partial $\eta^2 = .617$). Thus, the difference between the AI-integrated group and the control group was significant even after adjusting for differences. This is shown in Table 4

Table 4: ANCOVA for Tests of Between- Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	277.900 ^a	2	138.950	82.430	0.000	0.620
Intercept	519.270	1	519.270	308.049	0.000	0.753
pre_total	0.016	1	0.016	0.009	0.923	0.000
Group	274.140	1	274.140	162.629	0.000	0.617
Error	170.253	101	1.686			
Total	10218.000	104				
Corrected Total	448.154	103				

a. R Squared = .620 (Adjusted R Squared = .613)

Parameter estimates indicate that the group effect was negative for the reference category ([Group = 0], $B = -3.267$, $p < .001$), indicating that this group scored significantly lower on post-test performance compared to the control group. The confidence interval $[-3.775, -2.758]$ confirms the significance of this difference. In addition, pre-total gain indicated a significant contribution to post-test performance ($B = 0.007$, $p = .923$), thus, baseline scores did not influence final outcomes once the group effect was considered. Consequently, observed improvement in language outcomes were due to integration of AI into English language listening and speaking instruction for autistic learners in Nakuru east sub county. This is summarised in Table 5

Parameter	posttotal B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared
					Lower Bound	Upper Bound	
Intercept	11.274	0.577	19.536	0.000	10.129	12.419	0.791
pre_total	0.007	0.069	0.097	0.923	-0.130	0.144	0.000
[Group=0]	-3.267	0.256	-12.753	0.000	-3.775	-2.758	0.617
[Group=1]	0 ^a						

a. This parameter is set to zero because it is redundant.

Table 5: ANCOVA for Tests of Parameter Estimates**McNemar's Test and Marginal Homogeneity Test (Item-Level Effectiveness)**

The study used the McNemar's Test and the Marginal Homogeneity Test, to conduct an item-level analysis of the effectiveness of the AI intervention on specific language skills. This determined whether there were statistically significant changes in learners' responses between pre-test and post-test in reading, writing, vocabulary and oral communication. There was a statistically significant positive shift in learners' performance in the experimental group exposed to AI-assisted instruction, compared to the control group with conventional teaching methods. At baseline, both groups had challenges with reading comprehension, vocabulary, grammar and oral communication skills. However, post-intervention distributions reveal an improvement in the experimental group, indicated by a significant movement of learners from 'incorrect' to 'correct' response categories.

Item-level transitions reveal that improvements were mostly in foundational language tasks assessed through structured response items. Learners in the experimental group who initially indicated incorrect responses at pre-test transitioned to correct responses at post-test at significantly higher rates than those in the control group. The above trend was clearly observable in the case of basic comprehension skills and grammar tasks. Also, most learners that had problems with sentence building and language application skills at the onset of the experiment managed to transit to the right performance levels following the intervention. The control group, on the other hand, experienced relatively few improvements.

Qualitative analysis

Interviewees explained the effectiveness of AI-based language teaching in developing language skills for autistic students than conventional methods. An interviewee noted,

“AI-based language learning is better than traditional techniques. AI technologies provide instant feedback, allowing learners to rectify their errors instantly. It seems that learners become more engaged while using interactive applications than while undergoing classroom exercises through traditional teaching techniques. I have noticed quicker progress in the area

of vocabulary building and sentence construction using AI technologies.” [Teacher1, 05-05-2026]

Another interviewee explained,

“AI-assisted learning has greatly enhanced involvement and interaction from what used to be in place before. Students suffering from autism exhibit much better reaction to visually and interactively rich AI technologies rather than to verbally conveyed explanations. Traditional approaches do not always succeed at capturing the attention, whereas AI-assisted tasks keep students' attention longer. I can say that students become more confident while exercising their language skills using AI software.” [Teacher2, 05-05-2026]

It was evident,

“The use of AI in learning languages is flexible compared to the conventional approaches. This is because there are no set paces for learning that may be suitable for some learners and unsuitable for others. Learners are able to learn at their own pace, which is highly advantageous for children with autism. In addition, I have noticed that there is better recall of language concepts through repeated interaction with the AI systems.” [Teacher3, 06-05-2026]

Additionally, an interviewee remarked,

“... The use of AI-assisted teaching has proved to be more successful than traditional methods in helping autistic children acquire language skills. The former depends very much on the explanation by the teacher, whereas the latter provides learners with multisensory inputs to understand things properly. I have personally noticed great progress in the way learners can construct sentences and reply suitably with the help of AI-assisted techniques.” [Teacher4, 06-05-2026]

It was highlighted,

“Language teaching facilitated by AI offers an interactive approach that traditional language teaching fails to offer. Those who suffer from autism find it easier to learn with the help of applications that employ artificial intelligence due to their structured and repetitive nature. The traditional way of teaching may not offer sufficient flexibility required in the case of different learning styles. Improved communication has been observed, particularly in those who find it difficult to speak.” [Teacher5, 06-05-2026]

The researcher asked teachers the students emotional and behavioral reaction to language learning tool based on AI. An interviewee said,

“... a lot of them feel more at ease and less worried using these tools than in the traditional classroom environment. They appear to like the interactivity of the programs because it lessens their anxiety about making errors. There is more involvement and desire to try language exercises. Some previously shy learners now show interest in participating in activities.” [Teacher6, 07-05-2026]

Furthermore, it was claimed,

“... learners feel more confident and frustrated less because the tools guide them step by-step. They feel freer to make a number of attempts without the pressure coming from their fellow students. More concentration and longer attention span in class...when language exercises are presented with AI tools there is less avoidance behaviour” [Teacher3, 07-05-2026]

Additionally, an interviewee said,

“The signs of anxiety and stress during language learning activities are lowered when AI tools are implemented. They feel safer as the instructions are predictable and they also get immediate feedback. They have better rates of task completion and they are more reliable when given instructions. Some learners that were previously swimming in and out of attention now concentrate for long periods of time.” [Teacher5, 07-05-2026]

DISCUSSION

These findings align with those of Castellón et al. (2024), who emphasize that AI-powered tools possess adaptive and interactive capabilities that directly address the unique communication challenges experienced by autistic learners. Their argument that AI systems can respond to learners individualized social and linguistic needs supports the current finding that post-intervention outcomes are determined more by the instructional environment than by initial learner ability. Similarly, Taylor (2022) identified AI-based mobile applications as effective tools for supporting individuals with autism through features such as personalized content delivery, progress tracking and augmentative communication strategies. The findings are also in accordance with those of Elhadi (2023), who reported that technology-based educational intervention leads to better communication and language development of children suffering from autism. Furthermore, according to El Shemy (2022), the use of AI and adaptive technology in the teaching process helps develop customized approaches towards learning that address particular issues related to communication and concentration experienced by autistic learners. These customized approaches may have decreased the effect of previous ability on post-test performance as learners with varied levels of previous ability could receive targeted support through such approaches.

According to Shamsuddinova et al. (2024), educational technologies based on AI technologies improve social interaction, language learning and behavior in that the content of the instructions is adapted according to learners' needs. The above-mentioned results confirm the current study's result that the

improvement in learners' performance is associated with the adaptation and personalization of AI-assisted instructions. Shafiee (2024) argues that AI-supported learning environments provide adaptive and personalized instruction capable of improving communication and language development among learners with autism. Similarly, Gautam (2024) emphasize that intelligent tutoring systems and AI-supported educational technologies enhance learner engagement and individualized learning, leading to improved educational outcomes. The findings are further supported by Grecu (2023), who found that AI-driven instructional interactions positively influence learner responses and communication patterns. These results are consistent with the findings of Chen et al. (2020), where it is indicated that education tools that use AI technology and intelligent tutoring systems boost engagement and communication skills among individuals with autism due to personalized instruction.

Implications to Research Practice

The teacher training institutions and the Teachers Service Commission should enhance CPD initiatives that are oriented towards integrating AI in the teaching of languages. These initiatives will help the teachers acquire competency in handling the AI technologies. The ICT coordinators and Curriculum Support Officers within the school also need to continuously support the teachers in order to reduce the dependence on hit and trial approaches.

CONCLUSIONS

The study concludes that AI-supported language instruction is more effective than traditional teaching methods in improving language outcomes among learners with autism. Learners exposed to AI tools have greater improvement in language performance compared to those in conventional instruction. AI integration enhances consistent progress in reading, vocabulary, grammar and oral communication; thus, enhanced language acquisition and instructional effectiveness.

Future Research

This study examined the integration of AI into English language listening and speaking instruction for autistic learners in Nakuru east sub county. Further studies should be conducted in the larger county. Additionally, the study concluded included a test and interview guide in data collection. Further studies could incorporate a questionnaire, an observation guide and focus group discussion guide to better investigate integration of AI into English language. The study only included learners and teachers as respondents. Further studies could involve other stakeholders for example, ministry of education officials and curriculum developers.

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