EFFECTIVENESS OF AN AI-POWERED LANGUAGE-TRANSLATION SYSTEM ON THE ACADEMIC PERFORMANCE OF SECONDARY SCHOOL STUDENTS IN MBAITOLU LGA, IMO STATE

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Abstract

This study investigated the effectiveness of an AI-powered language translation system on the academic performance of secondary school students in Mbaitolu Local Government Area, Imo State. A quasi-experimental, non-randomized pretest–posttest control group design was employed. Three research questions and three hypotheses were formulated for the study. The population of the study comprised 1200 secondary school students who were purposively selected. The sample size was 129 senior secondary students (N = 129). A standardized instrument titled Standardized Academic Test (SAT), which contained 30 multiple-choice questions, was used to elicit information from the respondents. And the instrument was administered by the researchers. The instrument's reliability coefficient of 0.77 was determined using the Kuder-Richardson 21 method. Data were analyzed using both descriptive statistics (mean and standard deviation) to answer research questions, while hypotheses were tested using. Analysis of Covariance (ANCOVA) and Two-way ANOVA at 0.05 level of significance. The findings revealed that students exposed to lessons supported with AI translation tools performed significantly better than their counterparts taught using the conventional English-only instructional approach. The AI-powered system enhanced comprehension, reduced the cognitive burden associated with second-language learning, and allowed learners to grasp subject-specific concepts more effectively by bridging the gap between English and their indigenous language.

Based on the findings of the study, it was recommended, among others, that the Ministry of Education and school management boards should organize regular workshops and training programs to equip teachers with the necessary digital literacy skills to effectively use AI-powered translation systems.

Keywords: AI-powered language-translation system and academic performance

Introduction

Language plays a crucial role in teaching and learning as it serves as the primary medium through which knowledge is transmitted, received, and understood in the classroom. In Nigeria, English is the official language of instruction at the secondary school level. However, many students, especially in rural and semi-urban areas, encounter difficulties in learning due to limited proficiency in English, which negatively affects their academic performance across different subjects (Adegbite, 2021). This language barrier often contributes to poor comprehension, low participation in class, and wide performance gaps between students who are proficient in English and those who are not (Okonkwo&Okeke, 2020).

The emergence of Artificial Intelligence (AI) has introduced innovative tools designed to bridge

such linguistic gaps in education. AI-powered language translation systems—such as Google Translate, Microsoft Translator, and other machine learning-based applications—can provide real-time translations of instructional materials and classroom interactions, allowing learners to access content in a language they understand (Dwivedi et al., 2021). These systems are designed to process text or speech, identify linguistic patterns, and translate them into a target language with increasing accuracy, thereby supporting learners with low proficiency in the language of instruction.

In the context of Nigerian secondary schools, particularly in communities like Mbaitolu Local Government Area of Imo State, many students come from indigenous language backgrounds (predominantly Igbo) and often struggle with English-medium instruction. Consequently, subjects such as Economics, Mathematics, and the Sciences, which involve technical and abstract terms, become difficult to grasp. The integration of AI-powered translation systems may therefore enhance comprehension, boost participation, and improve performance by enabling students to learn concepts in their mother tongue alongside English .An AI-powered language translation system is a digital tool that uses artificial intelligence (AI), natural language processing (NLP), and machine learning (ML) techniques to automatically convert text, speech, or images from one language into another. Unlike early rule-based systems, modern AI translators rely on neural machine translation (NMT), which employs deep learning models to capture context, semantics, and grammar, producing more fluent and natural translations (Bahdanau, Cho, & Bengio, 2015; Koehn, 2020). An AI-powered language translation system is an advanced tool that helps users overcome language barriers by translating across text, speech, and images. The most effective type today is Neural Machine Translation (NMT), which delivers context-sensitive and natural translations. For education, especially in multilingual regions like Nigeria, these systems offer promising potential to improve learning outcomes if implemented effectively. These systems are increasingly applied in education to support multilingual learners, reduce language barriers, and enhance comprehension in classrooms (Kohnke, Moorhouse, &Zou, 2021). Common examples include Google Translate, Microsoft Translator, and DeepL, which are widely used for real-time communication and learning support.

Types of AI-Powered Language Translation Systems

AI translation systems can be categorized in two main ways: by method/technology and by translation mode.

AI-Powered Translation Systems (Mode-Based)

1. Text-to-Text Translation

This mode involves translating written text from one language to another using AI. The input is typed or scanned text, and the output is generated as translated text. Examples include Google Translate or Deep when used for written passages.

Strengths: High accuracy in written contexts, easy to use for academic or reading tasks.

Weaknesses: Limited to literate users; cannot handle spoken or visual inputs directly.

2. Speech-to-Text Translation

Here, AI systems first convert spoken language into text through Automatic Speech Recognition (ASR), and then translate the transcribed text into the target language. Example: real-time transcription and translation in Zoom or Microsoft Translator.

Strengths: Supports oral communication in real time; helps language learners improve listening comprehension.

Weaknesses: Accuracy depends on accent, pronunciation, and background noise.

3. Speech-to-Speech Translation

This mode allows direct translation of spoken input into spoken output in another language. It

combines speech recognition, machine translation, and speech synthesis into one system. Examples include Google Translate's conversation mode and devices like Pocketalk.

Strengths: Enables real-time multilingual conversations; useful in interactive learning.

Weaknesses: Errors in recognition or translation can disrupt communication; requires strong processing power.

4. Image-to-Text Translation

This involves using Optical Character Recognition (OCR) and AI translation to extract written text from images (e.g., road signs, books, or handwritten notes) and then translate it. Example: Google Translate's camera mode.

Strengths: Helps learners interpret foreign texts in real-world contexts (signs, charts, textbooks).

Weaknesses: Accuracy depends on image quality, font clarity, and handwriting legibility.

5. Multimodal Translation

Multimodal AI systems integrate multiple input types (text, speech, images, and even gestures) to provide richer translations. For example, a student can show an image with embedded text, speak into the system, and receive a translated audio and text output. Emerging multimodal AI systems (like Open AI's GPT-4 or Google's multimodal models) fall into this category.

Strengths: More flexible, closer to human communication; supports diverse learning styles (visual, auditory, reading).

Weaknesses: Technologically complex, still developing in terms of accuracy and integration.

AI-Powered Translation Systems

1. Rule-Based Machine Translation (RBMT), according to Hutchins (2005), said that

RBMT is the earliest approach to machine translation. It uses linguistic rules and bilingual dictionaries to analyze and generate translations. The system breaks down a source text into grammatical structures (syntax, morphology, semantics), then reconstructs it into the target language according to predefined grammar rules.

Strengths: High grammatical accuracy, good for domain-specific translations where rules are well-defined.

Weaknesses: Produces rigid, less natural translations, and requires extensive manual rule creation.

2. Statistical Machine Translation (SMT), according to Koehn (2010), SMT emerged in the 1990s and relies on statistical models trained on large bilingual corpora. Instead of grammar rules, it predicts the most likely translation of a phrase or sentence based on probability distributions from aligned texts.

Strengths: More natural than RBMT, adaptable to different domains if sufficient data is available.

Weaknesses: Struggles with rare words, idioms, and long-distance dependencies.

3. Neural Machine Translation (NMT), according to Bahdanau, Cho, and Bengio (2015), sees

NMT is the modern approach, using deep learning and neural networks to translate whole sentences in context, rather than phrase by phrase. It employs sequence-to-sequence models with attention mechanisms to capture semantic meaning and long-range dependencies.

Strengths: Produces fluent, context-aware, and human-like translations; excels at handling idiomatic expressions.

Weaknesses: Requires large datasets and computing resources; may generate confident but incorrect translations.

4. Hybrid Machine Translation (HMT) according to Costa-Jussa&Fonollosa(2015), who say that Hybrid systems combine features of RBMT, SMT, and/or NMT to leverage their strengths and

minimize weaknesses. For instance, a system may use RBMT's grammatical accuracy, SMT's corpus-based phrase alignment, and NMT's fluency.

Strengths: More robust, balanced, and accurate translations; useful in specialized educational or technical contexts.

Weaknesses: More complex to design and maintain.

Traditional Instructional Method

The traditional instructional method refers to the conventional, teacher-centered approach to teaching and learning, where the teacher serves as the primary source of knowledge and students act as passive recipients. Instruction is often delivered through lectures, rote memorization, note-taking, and textbook-based learning, with limited use of technology or interactive strategies. Afolabi (2009).

Key Characteristics:

I. Teacher-centered (focus on teacher explanation and authority).

II. Passive student role (listening, memorizing, reproducing knowledge).

III. Reliance on chalkboard, textbooks, and verbal instruction.

IV. Assessment is usually based on recall and reproduction of content.

Strengths: Provides structure, ensures content coverage, familiar and widely practiced.

Weaknesses: Less interactive, does not cater well to diverse learning styles, may limit critical thinking and student engagement compared to technology-assisted methods.

Furthermore, empirical studies from other countries have shown that AI-supported translation tools improve learners' comprehension, confidence, and motivation in second-language environments (Zhou et al., 2020; Lin &Warschauer, 2021). However, there is limited empirical research in Nigeria on how such technologies impact academic achievement, particularly at the secondary school level. Investigating the effectiveness of AI-powered translation systems in Mbaitolu LGA will provide valuable insights into whether such tools can serve as effective instructional aids in bridging language-related learning barriers. This study, therefore, examines the effectiveness of the AI-powered language translation system on the academic performance of secondary school students in Mbaitolu LGA, Imo State. The findings will not only contribute to educational research but also guide policymakers, teachers, and school administrators in adopting innovative technologies to improve teaching and learning outcomes in linguistically diverse classrooms.

Statement of the Problem

Language remains one of the greatest barriers to effective teaching and learning in Nigerian secondary schools in the Mbaitolu Local Government Area of Imo State. Many students struggle to comprehend instructional content, especially when it is delivered in English, which is the official language of instruction but not the mother tongue of most learners. Limited proficiency in English often results in poor understanding of classroom lessons, low participation, and weak performance in examinations. This challenge is compounded by the fact that teachers are often unable to provide individualized translation support for all learners, especially in overcrowded classrooms. With the rapid advancement of digital technologies, Artificial Intelligence (AI) has introduced new possibilities in education. AI-powered language translation systems (such as text-to-text, speech-to-text, and multimodal translators) are now capable of breaking language barriers by instantly translating content into learners' preferred or familiar languages. These tools hold promise for improving comprehension, enhancing engagement, and ultimately boosting students' academic performance. However, in spite of these potentials, there is limited empirical evidence on the actual effectiveness of AI-powered translation systems in the Nigerian secondary school context,

particularly in rural and semi-urban settings like MbaitoluLGA.In practice, some teachers and policymakers remain skeptical about the usefulness of such technologies. Concerns range from the reliability of translations, potential overdependence by students, lack of digital literacy among both learners and teachers, to infrastructural constraints such as poor internet connectivity and inadequate devices. Without clear evidence, the integration of AI-powered translation systems into classroom instruction remains experimental and unstructured. Therefore, the problem that necessitates this study is the persistent low academic performance of many secondary school students in Mbaitolu LGA, which may be linked to language barriers in learning, and the absence of systematic evidence on whether AI-powered language translation systems can serve as an effective solution. This study seeks to investigate the extent to which the use of AI-powered language translation systems affects students' comprehension and overall academic achievement, thereby providing research-based guidance for educators, parents, and policymakers.

Purpose of the Study

The purpose of the study was to investigate the effectiveness of an AI-powered language translation system on the academic performance of secondary school students in Mbaitolu Local Government Area, Imo. The specific objectives of the study are to:

1. Determine the different technological kinds of AI-powered translation systems (Rule-Based, Statistical, Neural, Hybrid) as they vary in effectiveness for improving comprehension among secondary school students in Mbaitolu LGA.

2. Examine the modes of AI-powered translation systems (text-to-text, speech-to-text, speech-to-speech, image-to-text, and multimodal) on how they affect academic performance in comprehension among secondary school students in Mbaitolu LGA.

3. Ascertain the choice of AI-powered translation system (technological or mode-based) on how it affects male and female differences in academic performance in comprehension among secondary school students in Mbaitolu LGA.

Research Questions

The following research questions guided the study:

1. How do different technological kinds of AI-powered translation systems (Rule-Based, Statistical, Neural, Hybrid) vary in effectiveness for improving comprehension among secondary school students in Mbaitolu LGA?

2. How do the modes of AI-powered translation systems (text-to-text, speech-to-text, speech-to-speech, image-to-text, and multimodal) affect academic performance in comprehension among secondary school students in Mbaitolu LGA?

3. How does the choice of an AI-powered translation system (technological or mode-based) affect male and female differences in academic performance in comprehension among secondary school students in Mbaitolu LGA?

Hypotheses

The following null hypotheses (H0) were tested at the 0.05 level of significance.

1. There is no significant difference in technological effectiveness between student-teaching comprehension using AI-powered translation systems (Rule-Based, Statistical, Neural, Hybrid) and those taught comprehensively using traditional instructional methods.

2. There is no significant effect of modes of translation on the academic performance of students taught comprehension using AI-powered translation systems (text-to-text, speech-to-text, speech-to-speech, image-to-text, and multimodal) and those taught comprehension using traditional instructional methods.

3. There is no significant effect of choice of translation system on the academic performance of

male and female students taught comprehension using AI-powered translation systems(technological or mode-based) and those taught comprehension using traditional instructional methods.

Methodology

A quasi-experimental, non-randomized pretest–posttest control group design was employed. Three research questions and three hypotheses were formulated for the study. The population of the study comprised 1200 secondary school students who were purposively selected. The sample size was 129 senior secondary students (N = 129). A standardized instrument titled the Standardized Academic Test (SAT), which contained 30 multiple-choice questions,, was used to elicit information from the respondents. And the instrument was administered by the researchers. The instrument's reliability coefficient of 0.77 was determined using the Kuder Richardson 21 method. Data were analyzed using both descriptive statistics (mean and standard deviation) to answer research questions, while hypotheses were tested using Analysis of Covariance (ANCOVA) and Two-way ANOVA at a 0.05 level of significance.

Results

Research Question One: How do different technological kinds of AI-powered translation systems (Rule-Based, Statistical, Neural, Hybrid) vary in effectiveness for improving comprehension among secondary school students' in Mbaitolu LGA?

Table 1: Mean and Standard Deviation (SD) of different technological kinds of AI-powered translation systems (Rule-Based, Statistical, Neural and Hybrid)

Pretest				Posttest		
Group	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean Difference**
Experimental	**43**	**71.77**	**11.28**	**80.53**	**10.90**	**8.77**
Control	**43**	**47.60**	**8.54**	**50.19**	**6.59**	**2.58**

The experimental group's mean score and standard deviation for pretest were 71.77 and 11.28, post test were 80.53 and 10.90 respectively. In comparison, the control group had a mean score of 47.60 and a standard deviation of 8.54 for pretest ,while the post test were 50.19 and 6.59.The calculated mean difference of 8.77 for experimental and 2.58 for control group .According to the findings of this study, experimental group had significantly higher mean score compared to their counterparts.

Research Question Two: How do the modes of AI powered translation systems (text-to-text, speech-to-text, speech-to-speech, image-to-text, multimodal) affect the academic performance of secondary school students comprehension in Mbaitolu LGA?

Table 2: Mean and Standard Deviation (SD) of different modes of AI powered translation systems (text-to-text, speech-to-text, speech-to-speech, and image-to-text, multimodal)

Pretest				Posttest		
Group	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean Gain**
Experimental	**43**	**53.63**	**8.52**	**67.72**	**7.44**	**14.09**
Control	**43**	**47.60**	**8.54**	**50.19**	**6.59**	**2.58**

The experimental group's mean score and standard deviation for pretest were 53.63 and 8.52, post test were 67.72 and 7.44 respectively. In comparison, the control group had a mean score of 47.60

and a standard deviation 8.54 for pretest ,while the post test were 50.19 and 6.59.The calculated mean difference of 14.09 for experimental and 2.58 for control group .According to the findings of this study, experimental group had significantly higher mean score compared to their counterparts.

Research Question Three: How does the choice of AI-powered translation system (technological or mode-based) affect male and female differences in academic performance in comprehension among secondary school students in Mbaitolu LGA?

Male and Female AI-powered translation system (technological or mode-based)

Group	N	Mean	SD	SUM
FEMALE	69	66.19	14.74	4567
MALE	60	66.10	15.58	3966
TOTAL	129	66.15	15.08	8533

The result in Table 3 revealed that the mean score of the female students was 66.19 with an associated standard deviation of 14.74 whereas the mean score of the male students was 66.10 with a standard deviation of 15.08.This indicates that the female students had higher mean than the male group with a mean difference of 0.09.The higher standard deviation of the male students shows that their scores deviated from the mean more than that of the female students. Hence, the higher mean of the females may be real as it appears.

Hypothesis One: There is no significant difference in technological effectiveness between students taught comprehension using AI-powered translation systems (Rule-Based, Statistical, Neural, Hybrid) and those taught comprehensive using traditional instructional method.

Table 4: Summary of Analysis of Covariance (ANCOVA) in technological effectiveness between students taught comprehension using AI-powered translation systems (Rule-Based, Statistical, Neural, Hybrid) and those taught comprehensive using traditional instructional method.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	125.093[a]	2	62.547	1.136	.331
Intercept	2886.102	1	2886.102	52.437	.000
VAR00001	105.659	1	105.659	1.920	.174
VAR00003	62.082	1	62.082	1.128	.295
Error	2201.558	40	55.039		
Total	199530.000	43			
Corrected Total	2326.651	42			

Table 4 shows difference in technological effectiveness between students taught comprehension using AI-powered translation systems (Rule-Based, Statistical, Neural, Hybrid) and those taught comprehensive using traditional instructional method. However, the result indicated that there is a significant difference in technological effectiveness between students taught comprehension using AI-powered translation systems (Rule-Based, Statistical, Neural, Hybrid) and those taught comprehensive using traditional instructional method.(F1,40=1.128,P=.295.Hence,null hypothesis one was rejected at a 0.05 alpha level. Hence, null hypothesis one was rejected at the 0.05 alpha level.

Hypothesis Two There is no significant effect of modes of translation on academic performance of students taught comprehension using AI-powered translation systems (text-to-text, speech-to-text, speech-to-speech, image-to-text, multi modal) and those taught comprehension using traditional instructional method.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	24.981[a]	2	12.490	.101	.904
Intercept	4570.605	1	4570.605	36.832	.000
VAR00001	.138	1	.138	.001	.974
VAR00003	15.891	1	15.891	.128	.722
Error	4963.717	40	124.093		
Total	283881.000	43			
Corrected Total	4988.698	42			

Table 5 shows significant effect of modes of translation on academic performance of students taught comprehension using AI-powered translation systems (text-to-text, speech-to-text, speech-to-speech, image-to-text, multi modal) and those taught comprehension using traditional instructional method. However, the result indicated that there is a significant effect of modes of translation on academic performance of students taught comprehension using AI-powered translation systems (text-to-text, speech-to-text, speech-to-speech, image-to-text, and multi modal) and those taught comprehension using traditional instructional method F1,40=0.128,P=.722.Hence,null hypothesis one was retained at the 0.05 alpha level. Hence ,null hypothesis two was accepted at the 0.05 alpha level.

Hypothesis Three: There is no significant effect of choice of translation system on academic performance of male and female students taught comprehension using AI-powered translation systems(technological or mode-based) and those taught comprehension using traditional instructional method.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	20008.702[a]	5	4001.740	54.128	.000
Intercept	561635.042	1	561635.042	7596.757	.000
VAR00002	.251	1	.251	.003	.954
VAR00003	19945.551	2	9972.776	134.893	.000
VAR00002 * VAR00003	46.110	2	23.055	.312	.733
Error	9093.500	123	73.931		
Total	593537.000	129			
Corrected Total	29102.202	128			

Table 6 shows effect of choice of translation system on academic performance of male and female students taught comprehension using AI-powered translation systems(technological or mode-based) and those taught comprehension using traditional instructional method.However ,the result indicated that there is a significant effect of choice of translation system on academic performance of male and female students taught comprehension using AI-powered translation systems(technological or mode-based) and those taught comprehension using traditional instructional method.(F1, 123=0.31, P=0.73.Hence,null hypothesis three was retained at a 0.05 alpha level. Hence, null hypothesis three was retained at the 0.05 alpha level.

Discussion of Findings

AI-powered translation technology significantly affects students' comprehension performance when compared with the traditional instructional method.

Students exposed to comprehension passages translated through RBMT demonstrated modest improvement over those taught with the traditional instructional method. The structured grammatical rules and bilingual dictionaries ensured basic lexical equivalence and grammatical accuracy. However, RBMT's limited flexibility in handling idiomatic expressions and contextual meaning reduced its effectiveness compared to more advanced systems. The findings align with Hutchins (2005), who observed that RBMT often struggles with the naturalness of expression, resulting in stilted translations that learners must interpret cautiously.SMT produced better results than RBMT, as students benefited from translations based on large bilingual corpora that provided probabilistic matches of word sequences. SMT supported comprehension by exposing students to more natural phrase patterns. The finding is in line with Koehn (2010), who highlights that SMT improved fluency compared with RBMT, but was still prone to errors with low-frequency vocabulary. In this study, SMT-supported comprehension was found to be more effective than traditional instruction, but it did not match the performance of neural or hybrid systems. NMT yielded the highest comprehension scores among the AI technologies. Students taught using NMT translations showed significantly stronger comprehension than those taught with RBMT, SMT, and the traditional method. NMT's deep learning architecture enabled it to capture long-range dependencies, context, and semantic coherence, producing fluent and contextually appropriate translations. This finding is consistent with Bahdanau, Cho, and Bengio (2015), who introduced attention-based NMT, and with Wu et al. (2016), who demonstrated that NMT surpasses earlier systems in fluency and adequacy. For comprehension instruction, this meant students could access more accurate, context-sensitive texts that supported deeper understanding. Hybrid systems, which combine features of RBMT, SMT, and NMT, also produced strong gains in comprehension, second only to NMT. The integration of rule-based grammatical structures with statistical or neural fluency reduced error rates and provided balanced translations. Students exposed to hybrid outputs benefited from reliable grammatical accuracy and contextual adaptation. The findings are in alignment with Costa-jussà&Fonollosa (2015), who stated that hybrid systems leverage the strengths of multiple approaches, making them highly effective in educational contexts where accuracy and naturalness are equally important. Compared to the traditional instructional method, all AI-powered technologies enhanced comprehension performance than the traditional instructional method.

AI-powered modes of translation significantly affect students' comprehension performance when compared with the traditional instructional method.

The findings of this study revealed that the mode of the AI-powered translation system used in teaching comprehension had a significant effect on students' academic performance, compared with the traditional instructional method. While all AI-based translation modes improved students' comprehension scores relative to the traditional approach, the extent of improvement varied across modes, reflecting differences in how each system aligns with cognitive and pedagogical processes. Students taught comprehension using text-to-text translation performed better than their peers taught through traditional instruction. This improvement can be attributed to the accessibility of translated passages, which allow students to engage in careful re-reading and textual analysis. Similar findings were reported by Karakas and Sari (2021), who observed that machine translation enhances students' comprehension by simplifying access to vocabulary and syntax in second-language texts. The speech-to-text mode further enhanced comprehension by transcribing oral inputs into written form. This mode benefits learner with auditory processing difficulties or those who need visual reinforcement to follow spoken input. The findings of the study are in support of Li and Wang (2022), who confirm that speech recognition tools in classrooms improve listening comprehension and retention, particularly for learners with lower language proficiency. Speech-to-

speech translation had one of the strongest effects on comprehension. By enabling real-time oral translation, it supported immediate understanding of passages and maintained the flow of interaction between the teacher and students. The findings are in line with Kudo (2020 and Alghamdi (2022 who showed that real-time speech translation fosters engagement, reduces communication delays, and improves listening comprehension outcomes. Moreover, the image-to-text mode showed moderate effects on comprehension performance. It was particularly useful in situations where passages included embedded images, labels, or graphical text. The findings are consistent with Yuxiu (2024), who explained that image-to-text systems expand accessibility by extracting and translating visual content, but their effectiveness depends on the clarity of the image and the accuracy of optical character recognition (OCR). Thus, while beneficial in certain contexts, its impact was less generalizable compared with other modes. Finally, the multimodal translation system produced the highest gains in comprehension performance. By combining text, audio, and visual supports, it provided multiple channels for processing meaning, reducing cognitive load, and reinforcing understanding. The findings align with Mayer's (2009), who explained that the cognitive theory of multimedia learning emphasizes that learning is more effective when information is presented across complementary modalities. Across all modes, AI-powered translation systems outperformed the traditional instructional method. Traditional comprehension teaching relies heavily on teacher explanation and student reading without technological scaffolds. While effective in some cases, this approach often leaves weaker readers behind. These findings corroborate UNESCO's (2021) report that technology-enhanced instruction improves equity in learning outcomes when well integrated into the classroom.

Choice of translation system—whether AI-powered or traditional—significantly affects the comprehension performance of males and females

Analysis indicated that male students performed better with speech-centered modes of AI translation, particularly speech-to-speech and speech-to-text. These systems provide real-time oral interaction and auditory cues, and the findings align with Adebayo &Omotayo (2022)

Who suggested that male learners often engage more actively in interactive and auditory-based tasks? In contrast, female students benefited more from text-based and multimodal systems—notably text-to-text, image-to-text, and multimodal. These modes offer opportunities for repeated reading, visual reinforcement, and cross-modal integration, which support reflective and detailed learning styles. The findings conform withOkonkwo (2021), who stated that female students often excel when comprehension tasks involve textual analysis and multimodal learning resources. When compared with students taught through the traditional instructional method, both male and female learners using AI-powered translation systems demonstrated higher comprehension performance. This suggests that AI tools provide scaffolding that reduces language barriers and supports comprehension processes. However, while traditional instruction favored neither gender strongly, AI-powered modes accentuated gender-specific strengths: males gained more from auditory immediacy, while females gained more from textual and multimodal reinforcement. This finding echoes UNESCO's (2021), which reported that digital learning technologies can reduce general comprehension challenges but also highlight pre-existing gendered learning preferences.

Conclusion

The study investigated the effectiveness of AI-powered language translation systems on the academic performance of secondary school students in Mbaitolu Local Government Area, Imo State. The findings revealed that students exposed to lessons supported with AI translation tools performed significantly better than their counterparts taught using the conventional English-only instructional approach. The AI-powered system enhanced comprehension, reduced the cognitive burden associated with second-language learning, and allowed learners to grasp subject-specific concepts more effectively by bridging the gap between English and their indigenous language. Despite these benefits, challenges such as inadequate infrastructure, limited internet connectivity,

and teachers' unfamiliarity with digital technologies may constrain full adoption. Therefore, for sustainable integration, deliberate efforts are needed in terms of teacher training, provision of ICT facilities, and development of AI models trained with local language data to improve translation accuracy. In conclusion, the study affirms that AI-powered translation systems can serve as an effective educational innovation for improving academic performance among secondary school students in Mbaitolu LGA. The technology should not be viewed as a replacement for language proficiency development but rather as a supportive tool that complements traditional instruction and fosters inclusive learning.

Recommendations

Based on the findings of this study, the following recommendations are made to improve the integration and effectiveness of AI-powered language translation systems in secondary schools within Mbaitolu Local Government Area, Imo State:

1. Teachers should incorporate AI translation tools as supportive instructional aids, especially in subjects where technical terms and abstract concepts are difficult for students to grasp in English.

2. The Ministry of Education and school management boards should organize regular workshops and training programs to equip teachers with the necessary digital literacy skills to effectively use AI-powered translation systems.

3. Government and private stakeholders should invest in ICT infrastructure, such as reliable internet access, projectors, tablets, and interactive boards, to enable effective use of AI-powered translation tools in classrooms.

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