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Perceived Impact of Artificial Intelligence, Digital Tools, and Pedagogical Innovations in Directed Writing in Secondary Schools in Eastern Nigeria

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Abstract

The integration of Artificial Intelligence (AI) and digital tools in directed writing instruction is transforming education globally. However, public secondary schools in Eastern Nigeria face challenges such as inadequate infrastructure, limited teacher training, and student adaptation difficulties. This study examines the perceived impact of AI-driven technologies and digital teaching methods on directed writing instruction in English language classrooms. Using a mixed-methods research design, the study targeted secondary schools across Anambra, Imo, Ebonyi, Abia, and Enugu states. A random sample of 150 students participated, and 36 validated questionnaires were administered to assess AI usage, engagement, and writing skill development. The questionnaire's validity and reliability were confirmed through expert review and a test-retest method yielding a Spearman correlation coefficient of 0.82. Structured interviews provided qualitative insights into AI adoption challenges. Data analysis involved descriptive and inferential statistics, with SPSS version 25 used to conduct a one-sample t-test and one-way ANOVA to determine significant relationships between AI usage and writing performance. Thematic analysis of qualitative data highlighted benefits and obstacles in AI integration. The findings indicated that AI tools enhance personalized learning, student engagement, and writing proficiency, though technological limitations, insufficient teacher training, and socio-economic factors hinder full implementation. The study recommends AI integration into the curriculum, improved teacher training, and enhanced technological infrastructure to support AI adoption. Addressing these barriers will create a more inclusive, technology-driven educational system, fostering digital literacy, writing proficiency, and educational equity in Eastern Nigeria's secondary schools.

Keywords: *Artificial Intelligence, Digital Tools, Directed writing, Pedagogical Innovations*

Introduction

The rapid evolution of technology has significantly transformed education worldwide, particularly in language learning. Artificial Intelligence (AI) and digital tools have emerged as powerful innovations, providing more personalized, interactive, and adaptive learning experiences. As English remains a global lingua franca and the primary medium of instruction in many countries, including Nigeria, leveraging AI in English language education presents new opportunities for improving teaching and learning. In Eastern Nigeria, where English is integral to academic success and career advancement, incorporating AI-driven tools in directed writing instruction is becoming increasingly relevant (Nwankwo, 2024; Bello, Obong, & Okoro, 2024).

However, despite the potential of AI to enhance writing proficiency, its adoption in public secondary schools across Eastern Nigeria faces multiple challenges such as limited access to technology, inadequate infrastructure, and insufficient teacher training hinder effective implementation (Adekunle, Johnson, & Adebayo, 2023). Additionally, socio-economic disparities and cultural resistance further slowdown the integration of AI-driven learning tools in schools. These challenges reflect broader issues in the Nigerian education system, where digital transformation efforts are often constrained by inadequate funding, outdated curricula, and limited professional development opportunities for teachers. Nevertheless, when properly implemented, AI can enhance student engagement, provide tailored feedback, and improve overall writing competence by offering real-time corrections, grammar suggestions, and interactive writing exercises (Olawale & Eze, 2025).

Given the growing need to integrate AI into classroom instruction, this study examines the transformative role of AI in directed writing instruction within Eastern Nigeria's public secondary schools. Specifically, it explores the extent to which AI enhances students' writing skills, improves engagement, and facilitates personalized learning. The study also seeks to identify the key challenges impeding AI adoption and assess potential strategies for overcoming them. By addressing these issues, this research aims to contribute to the development of an inclusive and technologically enriched educational system that supports both teachers and students.

The study is guided by two theoretical frameworks: the Technology Acceptance Model (TAM) and Constructivist Learning Theory. The Technology Acceptance Model (Davis, 1989) explains how perceived usefulness and ease of use influence technology adoption. In this context, TAM helps

evaluate how teachers and students perceive AI tools for directed writing instruction and how these perceptions impact their willingness to integrate these technologies into teaching and learning. Similarly, Vygotsky's (1978) Constructivist Learning Theory emphasizes active, student-centered learning through interaction, scaffolding, and adaptive feedback. AI-powered writing tools align with this framework by providing personalized learning experiences that allow students to practice and refine their writing skills independently while receiving AI-generated guidance and corrections. These theoretical perspectives offer a well-rounded approach to understanding both the psychological and pedagogical aspects of AI integration in language education.

A growing body of research highlights the role of AI in enhancing language instruction. Studies by Godwin-Jones (2023) and Chapelle & Sauro (2024) reveal that AI-driven platforms significantly improve grammar, vocabulary, and sentence structure by offering adaptive learning paths and real-time feedback. Additionally, AI-based tools enable students to identify and correct their mistakes independently, fostering self-directed learning and confidence in writing. However, despite these advantages, researchers such as Warschauer (2023) and Hubbard (2024) emphasize that digital literacy gaps among students and teachers, unreliable internet access, and a lack of policy support are significant barriers to AI integration, particularly in under-resourced regions. Furthermore, Fullan (2023) and Selwyn (2024) stress the need for well-structured policies, teacher professional development, and curriculum adaptation to facilitate the seamless adoption of AI technologies in schools.

While existing studies provide valuable insights into AI's impact on education, there remains a gap in research on its integration within the specific context of Eastern Nigeria. The unique challenges faced by public secondary schools in this region, including inadequate infrastructure, low teacher readiness, and resistance to technological change, require further investigation. This study builds on prior research by focusing on the localized experiences of teachers and students using AI for directed writing instruction. It aims to provide a clearer understanding of how AI tools can be successfully integrated into English language education despite infrastructural and socio-economic limitations.

The primary objective of this study is to explore the perceived impact of AI and digital tools on directed writing instruction in Eastern Nigeria's public secondary schools. It investigates how these technologies improve students' writing skills and engagement while also identifying obstacles such as

limited technological access, inadequate teacher training, and resistance to change. Additionally, the study assesses the impact of AI-powered educational tools on students' language proficiency and digital literacy. By offering practical recommendations—including strategies for enhancing teacher training, increasing access to technology, and fostering AI adoption—this research aims to create a more dynamic and supportive learning environment that maximizes the potential of AI in education. Through these efforts, the study seeks to contribute to ongoing discussions on educational innovation and digital transformation, ultimately promoting greater educational equity and improved learning outcomes in the region.

Research Questions

1. To what extent do AI and digital tools impact directed writing in Eastern Nigeria's secondary schools?
2. What are the challenges associated with integrating AI into directed writing teaching?
3. How effective are AI-driven pedagogical innovations in improving students' writing proficiency?
4. What strategies can be employed to enhance AI adoption in directed writings?

Hypotheses

Ho_1. There is no significant difference in student engagement and writing proficiency between AI-integrated instruction and traditional methods.

Ho_2. There is no statistically significant difference in the perceived challenges among different schools.

Ho_3. There is no significant difference in students' writing proficiency between AI-supported instruction and traditional methods.

Ho_4. There is no significant relationship between AI adoption strategies and the successful implementation of AI in directed writing instruction.

Methodology

This study employed a mixed-methods research design to explore the impact of Artificial Intelligence (AI) and digital tools on directed writing instruction in public secondary schools in Eastern Nigeria. The research specifically targeted schools in Anambra, Imo, Ebonyi, Abia, and Enugu states, addressing challenges such as inadequate infrastructure, limited teacher training, and student adaptation to new technologies.

A random sample of 150 students was selected from public secondary schools, and 36 validated questionnaires were developed based on the research questions and hypotheses to gather quantitative data on AI usage, its impact on student engagement and writing skills, and the challenges of AI adoption in directed writing instruction. The questionnaire was structured using a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) to facilitate statistical testing. Hypotheses were generated to assess statistical differences and relationships, ensuring that the study's objectives were aligned with inferential analysis.

To ensure validity and reliability, content and face validation were conducted by language education experts. The test-retest method was used to evaluate reliability, with the Spearman Correlation Coefficient yielding a value of 0.82, confirming the instrument's suitability. Inferential statistical tests were incorporated, including a one-sample t-test to determine the impact of AI tools on student engagement and writing proficiency, a one-way ANOVA to analyze differences in perceived AI adoption challenges across schools, and a chi-square test to assess relationships between AI adoption strategies and implementation success.

Data collection was carried out through personal visits to selected schools, ensuring clear explanations of the research purpose and addressing respondents' concerns. Completed questionnaires were collected on-site to maintain data integrity and reliability. In addition to survey data, qualitative insights were gathered through structured interviews with teachers, students, and administrators. These interviews explored challenges such as resistance to change, infrastructural limitations, and socio-cultural and economic barriers to AI adoption in schools.

The data analysis involved both statistical and thematic techniques. Descriptive statistics were used to summarize participants' responses, while inferential analysis was performed using SPSS version 25 to

identify significant differences and relationships based on the formulated hypotheses. Thematic analysis was applied to qualitative data, identifying recurring patterns related to the benefits and challenges of AI integration in directed writing instruction.

Results

This section presents the findings of the study, structured to address the key research questions and hypotheses. The results include both descriptive and inferential statistics, highlighting the statistical significance of AI's perceived impact on directed writing instruction. A respondent profile table has been included to provide insight into the demographic characteristics of participants, ensuring a clearer understanding of the study's sample distribution.

Table 1: Respondent Profile

Demographic Variable	Category	Frequency(n=150)	Percentage (%)
Gender	Male	75	50%
	Female	75	50%
Age Group	10 – 12 years	30	20%
	13 – 15 years	60	40%
	16 – 18 years	60	40%
Grade Level (Students)	Junior Secondary School (JSS 1 - 3)	50	33.3%
	Senior Secondary School (SS 1 - 3)	100	66.7%
Teaching Experience (Teachers Only)	1 – 5 years	30	20%
	6 – 10 years	45	30%
	Above 10 years	25	16.7%
AI and Digital Tool Usage	Used Before	80	53.3%
	Not Used Before	70	46.7%

Research Question 1: To what extent do AI and digital tools impact directed writing in Eastern Nigeria's secondary schools?

Table 1: Descriptive and Inferential Statistics for AI and Digital Tools Impact on Directed Writing Instruction

Variable	Mean	Standard Deviation	N	t-value	p-value
Impact on Student Engagement	4.35	0.72	150	3.21	0.002
Enhancement of Writing Skills	4.28	0.85	150	2.89	0.004
Personalization of Learning	4.42	0.68	150	3.78	0.001
Improvement in Digital Literacy	4.20	0.77	150	2.65	0.009

Note: A 5-point Likert scale was used (1 = Strongly Disagree, 5 = Strongly Agree). A one-sample t-test was conducted to determine whether mean scores significantly differed from the neutral midpoint (3.00).

Research Question 2: What are the challenges associated with integrating AI into directed writing teaching?

Table 2: Challenges to AI Integration in Directed Writing Instruction (ANOVA Results)

Challenge	Frequency (%)	Mean Agreement Score	N	F-value	p-value
Limited Technological Infrastructure	80%	3.15	150	4.21	0.003
Lack of Teacher Training	75%	3.32	150	3.89	0.005
Resistance to Technology Adoption	65%	3.48	150	2.76	0.015
Socio-Cultural Barriers	60%	3.55	150	2.54	0.021
Economic Constraints	70%	3.45	150	3.12	0.011

Note: One-way ANOVA was conducted to compare the perceived challenges among different schools.

Research Question 3: How effective are AI-driven pedagogical innovations in improving students' writing proficiency?

Table 3: Effectiveness of AI-Driven Pedagogical Innovations on Students' Writing Proficiency (Paired t-Test Results)

Variable	Mean	Standard Deviation	N	t-value	p-value
Improvement in Grammar and Syntax	4.10	0.91	150	3.45	0.002
Enhancement of Writing Structure	4.05	0.88	150	3.12	0.004
Increase in Writing Speed	3.95	0.85	150	2.98	0.006
Overall Writing Proficiency	4.15	0.78	150	3.87	0.001

Note: A paired sample t-test compared pre-test and post-test writing performance scores.

Research Question 4: What strategies can be employed to enhance AI adoption in directed writing?

Table 4: Strategies for Enhancing AI Adoption in Directed Writing Instruction (Chi-Square Test Results)

Strategy	Frequency (%)	Mean Agreement Score	N	χ^2 (Chi-square)	p-value
Increased Teacher Professional Development	85%	4.10	150	8.25	0.004
Improved Technological Infrastructure	90%	4.22	150	9.10	0.002
Integration of AI in the Curriculum	80%	4.00	150	7.35	0.006
Awareness Campaigns for Students	70%	3.75	150	6.15	0.010
Collaboration with Educational Stakeholders	75%	3.90	150	6.80	0.008

Note: A Chi-square test was conducted to analyze categorical responses.

Discussion of Findings

The findings from this study provide valuable insights into the impact of Artificial Intelligence (AI) and digital tools on directed writing instruction in Eastern Nigeria's secondary schools. In addition to assessing the effectiveness of AI-driven tools, the study explored the challenges associated with AI integration and strategies for improving its adoption. The results, as presented in Tables 1 to 4, highlight key trends regarding AI adoption, its effectiveness, and the obstacles related to its implementation in classrooms. Given these findings, there are significant implications for enhancing writing proficiency and overall educational outcomes.

Regarding Research Question 1, which examined the extent to which AI and digital tools impact directed writing instruction, the results indicate that AI-driven tools significantly enhance student engagement and personalization of learning. A one-sample t-test confirmed a statistically significant positive impact, particularly in personalization of learning ($t = 3.78$, $p = 0.001$) and student engagement ($t = 3.21$, $p = 0.002$). Since all p-values are below 0.05, we reject the null hypothesis (H_{01}) and conclude that AI and digital tools significantly improve student engagement and writing proficiency in directed writing instruction. Table 1 further detailed this impact, showing mean scores above 4.0 across all measured variables. These findings align with the research of Godwin-Jones (2023) and Chapelle & Sauro (2024), who demonstrated that AI-driven language learning platforms enhance writing skills, grammar, and vocabulary. Moreover, the strong impact of AI tools on student engagement highlights their ability to provide interactive and tailored learning experiences, a key advantage of AI applications in education. However, despite these benefits, infrastructural deficiencies remain a major barrier, as further highlighted in Table 2.

Similarly, Research Question 2, which investigated the challenges associated with integrating AI into directed writing instruction, the findings reveal key barriers to AI adoption in secondary schools. A one-way ANOVA confirmed statistically significant differences in perceived challenges across schools, particularly in limited technological infrastructure ($F = 4.21$, $p = 0.003$) and lack of teacher training ($F = 3.89$, $p = 0.005$). Since all p-values are below 0.05, the null hypothesis (H_{02}) is rejected and concludes that significant differences exist in the challenges of AI adoption across schools. As presented in Table 2, these findings align with Warschauer (2023) and Hubbard (2024), who identified digital literacy gaps and infrastructural constraints as major obstacles to the effective use of

technology in education. Additionally, Selwyn (2024) noted that resistance to AI adoption is often influenced by a lack of awareness and fear of technology, which further slows the process of AI integration in schools. Given these challenges, it is crucial to develop targeted interventions that address infrastructure gaps, improve teacher training, and create an environment conducive to AI adoption to ensure that all students can benefit from digital learning tools.

Furthermore, Research Question 3, which explores the effectiveness of AI-driven pedagogical innovations in improving students' writing proficiency, the results confirm a statistically significant improvement in writing skills. A one-sample t-test showed that AI-driven pedagogical innovations had a significant impact on students' writing proficiency, with t-values above 2.98 and p-values below 0.05. Furthermore, the mean scores for grammar and syntax improvement (4.10) and overall writing proficiency (4.15) indicate that AI tools effectively support the development of key writing skills. Since all p-values are below 0.05, the null hypothesis (H_{03}) is rejected and concludes that AI-driven pedagogical innovations significantly improve students' writing proficiency. These findings align with Chapelle & Sauro (2024), who reported that AI-driven language platforms contribute to better grammar and writing skills through personalized feedback. Additionally, the ability of AI to provide real-time corrections and tailored exercises enhances students' writing practices, fostering greater confidence and competence in their writing abilities.

For Research Question 4, which focuses on strategies for enhancing AI adoption in directed writing instruction, the findings suggest several key approaches. The most frequently recommended strategies were improved technological infrastructure (90%) and increased teacher professional development (85%), both of which were found to have statistically significant impacts on AI adoption. A chi-square test (χ^2) revealed that infrastructure improvement ($\chi^2 = 9.10$, $p = 0.002$) and teacher training ($\chi^2 = 8.25$, $p = 0.004$) were the most critical factors influencing AI adoption. Since the p-values are below 0.05, the null hypothesis (H_{04}) is rejected and concludes that AI adoption strategies significantly impact the successful implementation of AI in directed writing instruction. As outlined in Table 4, these findings align with Fullan (2023), who emphasized the need for targeted policy interventions to support teacher training and infrastructure development for successful AI integration. Moreover, the study highlights the importance of integrating AI into the curriculum and conducting awareness campaigns for students, strategies that align with Selwyn (2024), who argued that ongoing

professional development and curriculum redesign are critical for the effective implementation of AI tools in education.

Overall, the findings confirm that AI and digital tools have a significant positive impact on directed writing instruction in Eastern Nigeria's secondary schools. However, the full potential of these technologies is hindered by infrastructural limitations, lack of teacher training, and resistance to technology adoption. These results align with Godwin-Jones (2023) and Chapelle & Sauro (2024), who emphasized that well-developed infrastructure and teacher readiness are essential for AI implementation. To overcome these challenges, it is essential for schools to prioritize AI integration into the curriculum, invest in teacher training, and address infrastructural gaps. By implementing these measures, schools can create a learning environment that fosters digital literacy and writing proficiency, allowing students to fully benefit from AI-enhanced education. If these initiatives are effectively carried out, the transformative potential of AI in education can be realized, unlocking new opportunities for student learning and academic achievement in the region.

Conclusion

The findings of this study confirm that Artificial Intelligence (AI) and digital tools play a crucial role in enhancing directed writing instruction in Eastern Nigeria's secondary schools. The results indicate that AI significantly improves student engagement, personalizes learning, and enhances writing proficiency, particularly in grammar, sentence structure, and fluency. However, despite these benefits, several challenges hinder its widespread adoption, including limited technological infrastructure, inadequate teacher training, and resistance to technology. Additionally, socio-cultural and economic barriers further complicate the effective integration of AI in classroom instruction. Addressing these challenges requires a strategic approach that includes infrastructure development, teacher capacity building, curriculum integration, and policy support. If these measures are effectively implemented, AI has the potential to transform language education, equipping students with essential writing and digital skills necessary for success in an increasingly technology-driven world.

Recommendations

Enhancing technological infrastructure is essential for AI adoption in secondary schools. Schools should be equipped with reliable internet access and AI-compatible devices to support digital learning. Additionally, forming public-private partnerships can help fund AI-based learning resources and ensure sustainability.

Strengthening teacher training and professional development is crucial to integrating AI effectively. Regular training programs should be organized to familiarize teachers with AI tools and their instructional applications. Furthermore, workshops and seminars on AI-powered writing tools and digital literacy will enhance teachers' confidence and competence in using technology.

Integrating AI into the curriculum will ensure its structured and consistent use in writing instruction. Developing AI-based writing modules aligned with educational standards will help streamline learning. Collaboration between curriculum designers and technology experts will further optimize AI's role in teaching methodologies.

By implementing these recommendations, AI can be effectively leveraged to improve directed writing instruction, enhance digital literacy, and contribute to better educational outcomes in Eastern Nigeria.

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