

ARTIFICIAL INTELLIGENCE AND PERSONALIZED LEARNING: A PATHWAY TO REINVIGORATING STUDENTS ACADEMIC ENGAGEMENT IN ZONE A OF BENUE STATE

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Abstract

This paper examines the effects of Artificial Intelligence-based personalized learning on the academic engagement levels and performance of students in Zone A of Benue State. The study was guided by two research questions and two hypotheses which were formulated and tested. A quasi-experimental design was employed. The population comprised Upper Basic II students in Zone A of Benue State, with a sample size of 215 students selected for the study. Data collection instruments included academic engagement questionnaires and performance tests developed by the researcher. Descriptive statistics of mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses at a 0.05 level of significance. The findings revealed a significant difference in the academic engagement levels of students taught using AI-based personalized learning compared to those taught using conventional methods. Additionally, there was a significant difference in the mean performance scores of students taught with AI-based personalized learning and those taught conventionally. The study further found that challenges such as limited infrastructure, lack of training, and poor internet connectivity significantly affect the implementation of AI and personalized learning tools in Zone A secondary schools. It was recommended, among others, that educational stakeholders should invest in infrastructure, provide teacher training, and develop policies to support the effective adoption of AI-based personalized learning to enhance student engagement and performance in the gion.

Keywords: *Artificial Intelligence, Personalized Learning, Academics Engagement, Infrastructure, Learning Experience*

Introduction

Artificial Intelligence (AI) has increasingly become a transformative force in various sectors, with education standing out as one of the most promising fields of application. AI-powered tools and platforms enable personalized learning experiences that cater to the unique needs, pace, and interests of individual students (Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). This personalization has been found to improve student motivation, engagement, and academic outcomes by adapting instructional materials and feedback to suit learner profiles (Kumar, A., Sarkar, M., Davis, E. (2021). In developing regions, including parts of Nigeria, where educational resources and infrastructure may be limited, AI offers potential pathways to bridge learning gaps and enhance educational equity.

Zone A of Benue State, Nigeria, is an area facing educational challenges such as limited access to quality teaching, inadequate infrastructure and uneven student engagement (Benue State Ministry of Education, 2022). The introduction of AI

technologies and personalized learning initiatives, including the Nigeria Learning Passport (NLP), is part of ongoing efforts to address these challenges (UNICEF, 2023). These interventions are designed to reinvigorate students' academic engagement by providing more interactive, tailored and accessible learning experiences, especially in underserved communities within Zone A.

The Nigerian government, in collaboration with international organizations such as UNICEF, has prioritized the integration of AI and digital learning tools into public education systems. This strategic move aims to modernize the education sector, promote digital literacy, and prepare students for the future workforce (Federal Ministry of Education, 2023). Training programs for teachers and the establishment of smart schools equipped with digital resources further underscore this commitment. However, the impact of these technologies on actual student engagement and academic achievement, particularly in specific zones like Zone A of Benue State, remains under-researched.

Understanding how AI and personalized learning can reinvigorate academic engagement among students is crucial for tailoring future educational policies and practices. As the global education landscape shifts towards more technology-driven models, assessing localized applications helps ensure that interventions are contextually relevant and effective. Moreover, exploring the barriers and enablers of AI adoption in Zone A can provide insights into how to optimize technology use in similar regions.

This study thus focuses on the pathway AI and personalized learning offer to enhance students' academic engagement in Zone A of Benue State. By examining current initiatives, impacts, and challenges, the research aims to contribute valuable knowledge that informs educational stakeholders on maximizing AI's benefits in regional contexts.

Statement of the Problem

Despite the growing global interest in AI-enhanced education, many regions within Nigeria, including Zone A of Benue State, continue to grapple with low levels of students' academic engagement. Factors such as inadequate learning infrastructure, traditional teaching methods, and lack of access to personalized learning resources contribute to this problem (Benue State Education Report, 2022). This disengagement negatively affects academic performance, dropout rates, and future employability, thereby perpetuating cycles of poverty and underdevelopment in the area.

Furthermore, while AI and digital learning platforms have been introduced, the degree to which these tools effectively engage students in Zone A remains uncertain. The gap between technological availability, and actual usage, especially considering teacher readiness and student digital literacy, poses significant challenges (UNICEF, 2023). There is a need to critically assess whether AI-driven personalized learning is achieving its intended outcomes of increasing motivation and participation among students.

Additionally, limited empirical data exist regarding the specific impacts of AI interventions on academic engagement within the unique socio-cultural and infrastructural context of Zone A. Most available research on AI in education tends to focus on urban or developed settings, which may not translate directly to rural or

underserved areas (Adebayo & Nwosu, 2021). Hence, localized research is vital to identify contextual factors that influence the success or failure of these educational technologies.

Another problem is the uneven distribution of resources and digital devices necessary for AI-based learning, leading to disparities in access among schools and students in Zone A. These disparities can hinder equitable learning opportunities, further marginalizing vulnerable groups (Benue State Ministry of Education, 2022). Addressing such inequalities is essential to ensure that AI benefits all students and fosters inclusive academic engagement.

This study, therefore, seeks to identify the core problems limiting the effectiveness of AI and personalized learning in reinvigorating students' engagement in academics within Zone A of Benue State. By highlighting these challenges, it aims to inform targeted interventions that can bridge gaps and optimize the use of AI in education.

Purpose of the Study

The purpose of this study is to:

- To examine the effect of Artificial Intelligence-based personalized learning on the academic engagement levels of students in Zone A of Benue State.
- To identify the challenges and barriers affecting the effective implementation of AI and personalized learning tools in secondary schools within Zone A of Benue State.

Research Questions

The following research questions are formulated to guide the study:

- k. What is the effect of Artificial Intelligence-based personalized learning on the academic engagement levels of students in Zone A of Benue State?
- l. What are the challenges and barriers to the effective implementation of AI and personalized learning tools in secondary schools within Zone A of Benue State?

Hypotheses

The following hypotheses are formulated and tested for the study:

1. There is no significant effect of Artificial Intelligence-based personalized learning on the academic engagement levels of students in Zone A of Benue State.
2. Challenges and barriers such as limited infrastructure, lack of training, and poor internet connectivity do not significantly affect the implementation of AI and personalized learning tools in Zone A secondary schools.

LITERATURE REVIEW

Artificial Intelligence (AI)

Artificial Intelligence (AI) refers to the development of computer systems capable of performing tasks that typically require human intelligence, such as problem-solving, decision-making, and learning. In the context of education, AI technologies are increasingly being used to enhance teaching and learning processes by enabling automation, adaptive feedback, intelligent tutoring, and predictive analytics (Luckin, et al., 2016). These systems can assess individual learner needs and adapt content delivery accordingly, offering real-time support and data-driven insights to both students and educators. AI can also automate administrative tasks, giving teachers more time to focus on instruction and personalized support.

The integration of AI into education holds the promise of transforming how knowledge is delivered and how learning is experienced. AI-powered tools, such as

learning analytics platforms, chat bots, and recommendation systems, have shown potential in improving student engagement, retention and achievement (Holmes, W., Bialik, M., & Fadel, C. (2019).). However, the implementation of AI in schools, especially in under-resourced areas, is challenged by factors such as poor infrastructure, limited digital literacy among teachers, and ethical concerns around data privacy and algorithmic bias. Therefore, while AI offers significant benefits, its effective use requires careful planning, investment and policy support.

Personalized Learning

Personalized learning is an instructional approach that tailors learning experiences, content, pace, and style to meet the individual needs, skills, and interests of each student. It emphasizes student-centered learning, where learners take active roles in setting goals, managing progress and reflecting on their learning paths (Pane, J. F., Steiner, E. D., Baird, M. D., & Hamilton, L. S. (2015). With the aid of technology, personalized learning environments can adapt in real time to a student's performance, offering customized resources and feedback that foster deeper engagement and mastery of concepts. This approach has been shown to increase student motivation, self-efficacy, and academic achievement.

The application of personalized learning has gained momentum with the rise of digital technologies, including AI, which make it feasible to scale customized instruction. Tools such as adaptive learning software and intelligent tutoring systems enable teachers to track student progress and intervene when necessary, ensuring that no learner is left behind (Walkington, 2013). Despite its benefits, the successful implementation of personalized learning requires adequate teacher training, access to digital tools, and supportive policies that promote equity and inclusivity. Without these, the risk of widening the achievement gap remains a concern, particularly in regions with limited educational resources.

Overview of Artificial Intelligence in Education

Artificial Intelligence (AI) is increasingly recognized as a revolutionary force in education, capable of transforming traditional teaching and learning methods. It encompasses machine learning, natural language processing, and data analytics to provide intelligent tutoring systems, adaptive assessments and personalized feedback (Woolf, 2010). These AI-driven tools can analyze large datasets on student performance to tailor learning experiences to individual needs, thereby enhancing educational outcomes (Holmes et al., 2019). The shift towards AI in education is also supported by global digital transformation agendas aiming to prepare learners for the 21st-century workforce.

In developing countries, AI has the potential to overcome challenges related to teacher shortages, limited resources, and inconsistent education quality (Luckin, et al., 2016). By automating routine tasks and providing personalized support, AI can free teachers to focus on complex instructional activities and student engagement. Moreover, AI applications can reach remote or underserved areas through online platforms and mobile learning, democratizing access to education (Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). However, such implementation requires adequate infrastructure, policy support, and capacity building.

In summary, AI's role in education is multifaceted, offering solutions to longstanding challenges while presenting new opportunities and risks. Its application in diverse contexts rural or urban, developed or developing—requires nuanced understanding and adaptation. The review of existing literature highlights AI's

transformative potential as well as the need for thoughtful implementation strategies, particularly in regions like Zone A of Benue State where educational challenges are complex.

Personalized Learning: Concepts and Benefits

Personalized learning refers to educational approaches that tailor instruction, pacing, and content to meet the individual needs, skills, and interests of each learner (Walkington, 2013). Unlike one-size-fits-all methods, personalized learning leverages data, learner profiles, and adaptive technologies to create custom learning experiences. This approach empowers students by giving them more control over their learning paths, which can increase motivation, engagement and ultimately improve academic outcomes (Pane, et al., 2015).

Artificial Intelligence is a key enabler of personalized learning, providing the capability to continuously assess student performance and adapt learning materials in real-time. AI systems analyze patterns such as student responses, learning speed, and preferences to deliver content suited to each learner's needs (Woolf, 2010). For example, AI tutors can provide additional support on topics where a student struggles and accelerate through areas where they demonstrate mastery. This dynamic customization ensures that students remain challenged without becoming frustrated or bored.

Despite its advantages, implementing personalized learning requires robust infrastructure, teacher training and supportive policies (Walkington, 2013). Educators need to be skilled not only in using AI tools but also in interpreting data insights to guide instruction effectively. Thus, while personalized learning offers significant benefits, its success depends on contextual factors and careful integration into existing educational systems.

Academic Engagement: Challenges and Opportunities

Academic engagement is a critical factor influencing educational success and future opportunities. Engagement encompasses behavioral, emotional, and cognitive dimensions, reflecting how students participate in and value their learning experiences (Fredricks, Blumenfeld, & Paris, 2004). High levels of engagement correlate with better attendance, higher achievement, and lower dropout rates. However, many students, especially in underserved regions like Zone A of Benue State, face significant barriers that diminish their academic engagement.

One major challenge is the prevalence of traditional, teacher-centered instructional methods that fail to actively involve students in the learning process (Adekola & Abayomi, 2020). Such approaches often lead to passive learning, reducing motivation and interest. Coupled with inadequate educational resources and infrastructure, students may find it difficult to relate to or apply what they learn, resulting in disengagement. Furthermore, socio-economic factors such as poverty and household responsibilities can restrict students' ability to focus on academics (Benue State Ministry of Education, 2022).

Despite these challenges, opportunities exist to enhance students' engagement through innovative educational practices. Personalized learning enabled by AI is one such opportunity, as it allows for content to be tailored to student interests and learning styles, making education more relevant and appealing (Pane, et al., 2015). Technology-enabled platforms also provide interactive and multimedia content that can stimulate curiosity and participation. These tools are especially valuable in contexts where traditional schooling faces resource limitations.

Applications of AI and Personalized Learning in Nigeria

In Nigeria, the integration of Artificial Intelligence (AI) and personalized learning into the education sector has been gaining momentum as part of broader efforts to modernize learning and address systemic challenges. Various pilot projects and government initiatives have sought to leverage AI tools to improve access, quality, and relevance of education (Owolabi & Ogunleye, 2021). For example, the Nigeria Learning Passport (NLP), developed in partnership with UNICEF, provides a digital platform that supports personalized learning through AI-enabled content tailored to individual learner needs (UNICEF, 2023).

Beyond national programs, several educational institutions and startups are exploring AI applications to enhance learning experiences. AI-powered chat bots assist students in navigating curricula and provide instant feedback, while adaptive learning systems personalize content delivery based on real-time assessments (Adesina & Bello, 2020). These technologies help mitigate issues related to teacher shortages and uneven quality by offering consistent, customized instruction.

Despite these advancements, the adoption of AI in Nigerian education faces challenges such as limited internet connectivity, inadequate infrastructure, and digital literacy gaps among educators and students (Adewale, 2022). Furthermore, concerns about affordability and equitable access remain significant, especially in rural and underserved regions like parts of Benue State. This underscores the need for context-sensitive deployment of AI tools that consider local realities. To address these challenges, stakeholders have emphasized capacity building for teachers and students, infrastructural investment, and public-private partnerships (Owolabi & Ogunleye, 2021). Policymakers are also encouraged to develop regulatory frameworks that ensure data privacy, ethical AI use, and sustainable funding models. These efforts aim to create an enabling environment where AI-powered personalized learning can thrive and scale.

Overall, the Nigerian experience illustrates both the potential and complexity of applying AI in education within a developing country context. By drawing lessons from ongoing initiatives, Zone A of Benue State can tailor AI and personalized learning strategies to its specific needs, maximizing impact on students' academic engagement.

Methodology

The researcher adopted a quasi-experimental design, specifically the pre-test, post-test, non-equivalent control group design. According to Emaikwu (2014), quasi-experimental design involves the administration of pre- and post-tests in intact classes without randomization of subjects. This design was chosen because true experimental designs are difficult to implement in school settings, as certain classroom situations do not easily allow for random assignment of students.

The population of this study comprised Upper Basic II students in Education Zone A of Benue State, totaling 29,567 students, comprising 15,202 males and 14,365 females (Teaching Service Board). A sample of 215 students, including 113 males and 102 females, was used for the study. A multi-stage sampling technique was employed. Simple random sampling was used to select two local government areas (Vandeikya and Ushongo) from Education Zone A. Purposive sampling was then used to select two secondary schools from each of the selected local government areas.

Data collection instruments included the Academic Engagement Questionnaire (AEQ) and the Performance Test on Social Studies developed by the researcher. The AEQ consists of two sections: Section A collects biodata such as gender, while Section B contains 20 items assessing academic engagement with response options ranging from very high (4 points), high (3 points), low (2 points), and very low (1 point) for positively framed items; reverse scoring was applied to negatively framed items. Respondents selected the option that best expressed their level of academic engagement. The Performance Test consisted of 40 multiple-choice items covering topics such as culture, marriage, family, and drug abuse from the Upper Basic II Social Studies curriculum.

Mean and standard deviation were used to answer the research questions. Analysis of Covariance (ANCOVA) was employed to test the hypotheses at the 0.05 level of significance. ANCOVA was chosen because the hypotheses involved testing the significant effect of the independent variable (AI-based personalized learning) on dependent variables (academic engagement and performance), while controlling for pre-test scores as covariates.

Results

The results of data analysis and interpretation are presented in accordance with the research questions and hypotheses that guides the study:

Research Question One: What is the effect of Artificial Intelligence-based personalized learning on the academic engagement levels of students in Zone A of Benue State?

Table 1: Mean and Standard Deviation of Academic Engagement Ratings of Students Taught Using AI-Based Personalized Learning and Conventional Approaches

A p p r o a c h	Pre-Engagement		Post-Engagement		Mean Gain
AI-Based Personalized	Mean:	1.89	Mean:	3.35	1.46
	SD:	0.44	SD:	0.32	
	N =	98	N =	98	
C o n v e n t i o n a l	Mean:	1.88	Mean:	1.95	0.07
	SD:	0.26	SD:	0.41	
	N =	117	N =	117	
Mean Difference		0.01		1.40	1.39

Table 1 presents the mean and standard deviation of academic engagement ratings for students taught using AI-based personalized learning and those taught using conventional learning approaches in secondary schools in Zone A of Benue State. At the pre-test stage, students exposed to AI-based personalized learning had a mean academic engagement score of 1.89 (SD = 0.44), while those taught using the conventional method had a mean score of 1.88 (SD = 0.26). This shows a negligible difference in initial engagement levels between the two groups. At the post-test stage, the mean engagement score of students taught with AI-based personalized tools increased significantly to 3.35 (SD = 0.32), indicating a high level of improvement in engagement. In contrast, the conventional group only slightly improved to a mean of

1.95 (SD = 0.41).The mean gain in academic engagement for the AI-based group was 1.46, compared to 0.07 for the conventional group. This shows that students who engaged with AI-personalized learning tools improved significantly more in their academic engagement. Overall, the mean difference in engagement gain between the two groups is 1.39, suggesting a strong positive effect of AI-based personalized learning on students’ academic engagement levels.

Research Question Two: What are the challenges and barriers to the effective implementation of AI and personalized learning tools in secondary schools within Zone A of Benue State?

Table 2: Mean and Standard Deviation of Perceived Challenges to Implementing AI and Personalized Learning Tools in Secondary Schools in Zone A

A p p r o a c h	Pretest (Challenge Rating)		Posttest (Challenge Rating)		Mean Change (Reduction)
AI Implemented Schools	Mean:	8.04	Mean:	17.62	9.58
	SD:	1.60	SD:	1.39	
	N =	98	N =	98	
Conventional Schools	Mean:	6.99	Mean:	10.72	3.73
	SD:	1.49	SD:	1.57	
	N =	117	N =	117	
Mean Difference		1.05		6.90	5.85

Table 2 presents the mean ratings and standard deviations of the challenges and barriers perceived by respondents regarding the implementation of AI and personalized learning tools in secondary schools within Zone A of Benue State. During the pretest, schools with AI implementation reported a mean challenge rating of 8.04 (SD = 1.60), while conventional schools (without AI tools) reported a slightly lower mean rating of 6.99 (SD = 1.49). This indicates that initially, AI schools perceived more or greater challenges, possibly due to the complexity and novelty of the technology. In the posttest, after a period of intervention (such as training, awareness, or initial implementation phase), AI-implemented schools reported a significantly higher mean challenge rating of 17.62 (SD = 1.39). The large increase may reflect a more comprehensive identification or acknowledgment of challenges over time. Conventional schools showed a smaller increase from 6.99 to 10.72 (SD = 1.57), possibly reflecting ongoing challenges in traditional teaching methods or lesser exposure to AI-related barriers. The mean change (increase in awareness or reporting of challenges) for AI schools was 9.58, compared to 3.73 for conventional schools. This suggests that the nature and extent of challenges are more pronounced or better recognized in AI settings. The mean difference between the two groups in terms of challenge ratings is 5.85, indicating that AI-based schools face more significant barriers to effective implementation than conventional schools.

Hypothesis: There is no significant effect of Artificial Intelligence-based personalized learning on the academic engagement levels of students in Zone A of Benue State.

Table 3: ANCOVA Result of the Difference in Mean Academic Engagement Ratings of Students Taught Using AI-Based Personalized Learning and Conventional Approaches

S o u r c e	Type III Sum of Squares	D f	Mean Square	F	Sig.
Corrected Model	105.126a	2	52.563	375.808	.000
I n t e r c e p t	54.042	1	54.042	386.379	.000
P r e - e n g a g e m e n t	0.049	1	0.049	0.352	.553
Method (AI vs Conventional)	105.124	1	105.124	751.596	.000
E r r o r	29.652	212	0.140		
T o t a l	1572.155	215			
Corrected Total	134.778	214			

a. R Squared = .780 (Adjusted R Squared = .778)

The ANCOVA results in Table 3 examine whether there is a significant difference in the mean academic engagement ratings between students taught using AI-based personalized learning and those taught using conventional approaches, while controlling for pre-engagement scores. The F-value for the method (teaching approach) is 751.596 with a p-value of .000, which is less than the significance level of 0.05. This means the difference in engagement levels between the two groups is statistically significant. The pre-engagement covariate had an F-value of 0.352 with a p-value of 0.553, indicating no significant influence on post-engagement scores. The corrected model explains approximately 78% of the variance in academic engagement ($R^2 = 0.780$). Since the p-value for the method is less than 0.05, the null hypothesis stating *there is no significant effect of AI-based personalized learning on academic engagement* is rejected. Therefore, evidence from this analysis suggests that AI-based personalized learning significantly affects academic engagement levels of students in Zone A of Benue State compared to conventional learning methods.

Hypothesis Two: Challenges and barriers such as limited infrastructure, lack of training, and poor internet connectivity do not significantly affect the implementation of AI and personalized learning tools in Zone A secondary schools.

Table 4: ANCOVA Result of the Difference in the Mean Performance Scores of Students Taught Using AI-Based Personalized Learning and Conventional Approaches

S o u r c e	Type III Sum of Squares	D f	Mean Square	F	Sig.
Corrected Model	2548.503a	2	1274.251	578.975	.000
I n t e r c e p t	1936.445	1	1936.445	879.852	.000
P r e t e s t	6.137	1	6.137	2.789	.096
Method (AI vs Conventional)	2355.220	1	2355.220	1070.128	.000
E r r o r	466.586	212	2.201		
T o t a l	44347.000	215			
Corrected Total	3015.088	214			

a. R Squared = .845 (Adjusted R Squared = .844)

Table 4 presents the ANCOVA analysis results comparing the mean performance scores of students taught using AI-based personalized learning tools and those taught with conventional methods in Zone A secondary schools, considering challenges and barriers such as infrastructure, training, and connectivity. The F-value for method (teaching approach) is 1070.128 with a p-value of .000, which is less than the 0.05 significance level. This indicates a statistically significant difference in mean performance scores between students taught with AI-based personalized learning and those taught conventionally. The pretest covariate (initial performance scores) had an F-value of 2.789 with a p-value of 0.096, which is greater than 0.05, indicating no significant effect of initial performance on posttest results. The corrected model explains about 84.5% of the variance in students' performance ($R^2 = .845$). Since the p-value for method is less than 0.05, the null hypothesis stating that challenges and barriers do not significantly affect AI implementation is rejected. Therefore, based on the data, challenges such as limited infrastructure, lack of training, and poor internet connectivity do significantly affect the implementation and effectiveness of AI and personalized learning tools in Zone A secondary schools.

Discussion of Findings

This study examined the effect of Artificial Intelligence (AI)-based personalized learning on the academic engagement levels of students in Zone A of Benue State, as well as the influence of challenges and barriers on the implementation of AI and personalized learning tools in secondary schools within the zone.

The findings from Hypothesis One revealed a significant difference in the mean academic engagement ratings between students taught using AI-based personalized learning and those taught using conventional approaches. Specifically, the ANCOVA results showed that the teaching method had a statistically significant effect on engagement ($F(1,214) = 751.596, p = .000$). This indicates that AI-based personalized learning significantly enhances students' academic engagement compared to traditional teaching methods.

This finding aligns with studies by Luckin, et al. (2016), who found that personalized and technology-enhanced instructional methods increase student engagement more effectively than conventional strategies. Similarly, Holmes, et. al. (2019) reported that innovative learning strategies that cater to individual student needs stimulate interest and sustained engagement. The significant effect observed in this study could be attributed to the adaptability of AI-based tools, which tailor learning experiences to individual abilities and preferences, thereby fostering higher motivation and active participation.

In terms of Hypothesis Two, the analysis showed a significant difference in the mean performance scores of students taught using AI-based personalized learning tools versus conventional methods ($F(1,214) = 1070.128, p = .000$). Contrary to the null hypothesis, this implies that challenges such as limited infrastructure, lack of training, and poor internet connectivity do significantly affect the implementation and effectiveness of AI and personalized learning in Zone A secondary schools.

This outcome corroborates findings from Holmes, et. al. (2019), who emphasized that collaborative and technology-enhanced learning approaches improve performance, but successful implementation depends heavily on adequate infrastructure and teacher preparedness. The significant impact of infrastructural and resource barriers are understandable because AI tools require reliable internet access, technical support, and trained personnel to maximize their potential. Without these supports, the effectiveness of AI-based personalized learning is compromised.

Implications

The findings have important implications for various stakeholders. Educators need support and training to effectively integrate AI-based personalized learning into their teaching, enhancing student engagement and performance. Policy makers and school administrators must prioritize investment in technology infrastructure, such as reliable internet and adequate hardware, to overcome current barriers in Zone A secondary schools. Curriculum development should focus on student-centered approaches that take advantage of AI's capabilities to promote active learning and deeper understanding.

Conclusion

This study shows that AI-based personalized learning significantly improves academic engagement and performance among students in Zone A, Benue State, compared to traditional teaching. Students using AI-driven methods demonstrated higher participation and better results, highlighting AI are potential to customize learning and boost involvement. However, challenges like poor infrastructure, lack of teacher training, and limited internet access hinder effective implementation. To maximize AI's benefits, strategic investments in infrastructure, teacher capacity building, and equitable technology access are essential. The study emphasizes that a supportive environment is crucial for successful, sustainable integration of AI in education in Benue State.

Recommendations

Based on findings of the present study, the following recommendations are outlined:

- xv. Government and educational authorities in Zone A of Benue State should prioritize improving school infrastructure by providing reliable internet access, adequate hardware (computers, tablets) and necessary technological resources to support the effective implementation of AI-based personalized learning tools.
- xvi. Teachers should receive ongoing professional development and training programs focused on the use of AI and personalized learning technologies. This will enhance their skills and confidence in integrating these tools into their instructional practices, thereby maximizing student engagement and learning outcomes.
- xvii. Policymakers should create and enforce supportive policies that encourage the adoption of AI-driven personalized learning across secondary schools. Adequate funding should be allocated to ensure schools can sustain technology use and overcome barriers related to maintenance and upgrades.

- xviii. Schools should promote awareness among stakeholders including students, parents, and community members about the benefits and challenges of AI-based learning. Collaborative efforts involving educators, technology experts, and policymakers can help address implementation challenges and tailor solutions to local needs.

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