

ARTIFICIAL INTELLIGENCE-INTEGRATED HOLISTIC FRAMEWORK FOR TEACHER EDUCATION TO ENHANCE INSTRUCTIONAL EFFECTIVENESS IN DIVERSE EDUCATIONAL ENVIRONMENTS IN BAYELSA STATE

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Abstract

This research examined the roles of an AI-Integrated Holistic Framework for teacher education to enhance instructional effectiveness in diverse educational environments in Bayelsa State. The study was guided by two research questions and two null hypotheses. Descriptive survey research design with a mixed-methods approach was adopted for the study. The population consisted of 1055 respondents, including teacher educators and final year students, from four institutions that offer Teacher Education programmes in Bayelsa State. A sample size of 284 was chosen using a simple random sampling technique. Data were collected through a structured questionnaire, titled “AI-Integrated Holistic Framework for Teacher Education Questionnaire (AIHFTE)”. The instrument was validated by three research experts. Reliability of the instrument was determined using Cronbach alpha statistic which yielded 0.82 and 0.84 for clusters 1 and 2 with an overall reliability index of 0.83. The research questions were answered using mean and standard deviation, while Analysis of Variance (ANOVA) was used to test the null hypotheses at 0.05 alpha level. The findings of the study showed that AI-Integrated Holistic Framework played a significant role for teacher education in the enhancement of instructional effectiveness in diverse educational environments in Bayelsa State. In view of the findings, the researchers recommended that there is need in leveraging the framework, implementing comprehensive training programmes, and fostering collaborative efforts among stakeholders. While acknowledging the existence of challenges, the study underscores the dynamic nature of integrating educational technology and emphasizes the importance of strategic and collaborative endeavors for the successful integration of AI into teacher education in Bayelsa.

Keywords: Artificial Intelligence, Holistic Framework, Teacher Education, Instructional Effectiveness, Diverse Educational Environments

Introduction

In the heart of Nigeria, the landscape of education is both rich with potential and challenged by various factors, and education, being a fundamental pillar of societal development, constantly grapples with the challenge of meeting the evolving needs of diverse student populations. The advent of Artificial Intelligence (AI) has emerged as a promising avenue to revolutionize traditional teaching methodologies and address the complexities faced by educators in diverse educational settings (Jones & Martinez, 2019).

As we delve into the study of an "AI-Integrated Holistic Framework for Teacher Education Enhancing Instructional Effectiveness in Diverse Educational Environments in Bayelsa State," it is imperative to understand the nuanced intersection of Artificial Intelligence (AI), teacher education, and the diverse educational settings prevalent in the region.

The term "AI-Integrated Holistic Framework" is comprehensive approach in teacher education that seamlessly integrates Artificial Intelligence into the entire spectrum of training, bridging the gap between theory and practice (Brown et al., 2021). This framework envisions a symbiotic relationship between AI technologies, pedagogical theories, and practical teaching skills, aiming to enhance the overall effectiveness of instructional strategies. This framework aims to synergize traditional teaching methodologies with advanced AI technologies, creating a cohesive and interconnected system that addresses various aspects of teacher education.

Traditional teacher education models before now, often struggle to address the dynamic challenges of modern classrooms. These struggles ranges from struggle to keep pace with evolving educational theories, research, and best practices, Lack of extensive hands-on classroom experience can leave teachers unprepared for the challenges of real-world teaching. Challenges of addressing the diverse needs of students and promoting cultural competence among teachers, as well as the challenges in attracting and retaining high-quality candidates into the teaching profession, include the necessity for ongoing professional development, the creation of inclusive curricula, the provision of adequate support and resources for teachers, and the implementation of policies that make the teaching profession more appealing and sustainable. All the listed above leaves teachers ill-equipped for modern classrooms leading to a gap between educational demands and teacher preparedness, which ultimately impacts student learning outcomes and the overall effectiveness of the education system (Zeichner, Payne & Brayko, 2015).

Modern classroom represents a paradigm shift in education, emphasizing dynamic, learner-centered approaches that leverage technology, collaboration, and flexible teaching methodologies. This transformation aims to prepare students for the complexities of the 21st century by integrating innovative practices and adapting to the diverse needs of today's learners. The diverse needs of today learner include the following, integration of innovative teaching methods, technology, and flexible learning environments. A shift of focus from the teacher to the student, allowing for personalized and self-directed learning, can enhance student engagement and motivation, cater to individual learning styles, and promote deeper understanding and retention of knowledge. That is a departure from traditional teacher-centric models; modern classrooms prioritize student-centered learning. This approach emphasizes personalized instruction, self-directed exploration, and critical thinking, empowering students to take an active role in their education. However without the integration of AI, educators may encounter difficulties in adapting to these diverse learning needs, keeping pace with technological advancements, and effectively bridging the gap between theoretical knowledge and practical application (Johnson, 2018).

The integration of Artificial Intelligence (AI) into teacher education is a transformative endeavor that promises to reshape the landscape of pedagogy. This concept envisions a synergistic relationship between AI technologies and teacher training programs, fostering a new generation of educators equipped with advanced tools and methodologies. Also teachers can leverage AI analytics to make informed decisions based on real-time student

performance data, enabling targeted interventions and support (Siemens & Long, 2011). Again, AI-powered assessment tools provide timely and accurate evaluations, reducing the administrative burden on educators and allowing for more focused instructional planning (Baker, 2017). And enable the adaptation of teaching strategies in response to student progress, ensuring that instruction remains dynamic and responsive to evolving educational needs (Dede, 2017). Not all, AI supports the creation of innovative and engaging curricula by identifying trends in educational content and recommending updates or enhancements (Wiley, 2017). Above all, AI can offer personalized professional development opportunities for teachers, addressing specific areas of growth and keeping educators abreast of the latest pedagogical advancements (O'Byrne et al., 2018).

In order to ensure a meaningful and relevant teacher education programme, it is important to consider the integration of an AI-Integrated Holistic Framework. This framework represents a comprehensive approach to teacher education, which combines the power of Artificial Intelligence with a holistic view of teaching methodologies. It is essential to seek out this framework for a robust teacher education program that seamlessly blends various elements together. When we refer to the term "holistic" in this context, we are highlighting an inclusive strategy that incorporates theory, practical application, and AI-driven insights. This integration is crucial as it aims to optimize instructional effectiveness and provide teachers with a well-rounded understanding of their profession.

It, therefore, becomes of utmost significance that a comprehensive and integrated framework, incorporating Artificial Intelligence, is thoroughly investigated and analyzed for the purpose of enhancing the effectiveness of instructional methods in diverse educational settings within the state of Bayelsa. This imperative stems from the unique and distinctive characteristics associated with the aforementioned region, most notably the prevalent issue of flooding. As stated by Osaji (2022), the detrimental impact of floods in Bayelsa is far-reaching, affecting not only agricultural lands but also crucial infrastructures such as educational institutions, healthcare facilities, and various other amenities. The consequences of this natural disaster extend to approximately 300 communities spread across the eight Local Government Areas within the state. Furthermore, an independent research study conducted by Endurance, Ogbangain and Jack (2014), revealed a concerning aspect of the educational landscape in Bayelsa, namely the inadequate attention and substandard allocation of resources by government bodies towards the development of rural education. This neglect has resulted in poor quality human and material resources within the rural education sector. In addition to these factors, Bayelsa has been selected as a focal point of this investigation due to the presence of five universities and one college of Education within its boundaries. Notably, these tertiary institutions are divided among different governing bodies, with one being under federal jurisdiction, three under state control, and one being privately owned (Olusegun, 2012).

It, thus, emerges as a matter of utmost significance that a Holistic Framework for Teacher Education, seamlessly integrated with AI, be thoroughly examined in order to optimize instructional efficacy in diverse educational settings in a state like Bayelsa. This imperative stems from the distinctiveness characterizing Bayelsa, including the prevalence of flooding. According to Osaji's research (2022), a considerable number of agricultural lands, educational edifices, healthcare facilities, and other vital infrastructures suffered the consequences of this inundation. Moreover, the flood detrimentally impacted around 300 communities across all eight LGAs in the state. In addition to the flooding

predicament, a separate investigation conducted by Endurance, Ogbangain and Jack (2014), brought to light the fact that governmental educational policies in Bayelsa neglect the development of the rural education sector.

Regrettably, the provision of educational resources, both human and material, to rural areas remains inadequate and uncared for. Furthermore, Bayelsa warrants attention due to its diverse educational landscape, housing five universities and one college of education. Among these institutions, one is federally owned, three are under state jurisdiction, and one operates as a private entity (Olusegun, 2012). Hence the reason for this study titled *AI-Integrated Holistic Framework for Teacher Education to Enhance Instructional Effectiveness in Diverse Educational Environments in Bayelsa State, Nigeria*.

Statement of Problem

Despite the recognition of AI as transformative in education, there is a gap in understanding how to implement an AI-Integrated Holistic Framework in Bayelsa State. Teacher education needs to integrate AI seamlessly and address the needs of diverse educational contexts in the area. The lack of understanding hinders the development of an effective AI framework tailored to the local educational landscape. The problem can be divided into key components: **Integration Challenges:** Investigating obstacles and complexities in integrating AI into the teacher education framework in Ogbia LGA. **Alignment of Theory and Practice:** Exploring the disconnect between theoretical knowledge and practical application in diverse classroom settings, and how AI can bridge this gap. **Adaptation to Diverse Educational Environments:** Understanding the nuances of diverse educational environments in Bayelsa State and tailoring the AI framework accordingly. **Impact on Instructional Effectiveness:** Evaluating the impact of the AI framework on instructional effectiveness and student engagement in Bayelsa State. This research aims to address these issues and develop an effective AI framework for teacher education in Bayelsa State, enhancing instructional practices in diverse educational environments.

Objectives of the Study

Generally, the main objective of this study was to assess the impact of an AI-Integrated holistic framework on the teacher education enhance instructional effectiveness in diverse educational environments in Bayelsa State. Specifically, the study sought to:-

- I. assess the extent to which the alignment of theoretical knowledge, practical teaching skills, and AI technologies will contribute to the overall enhancement of teacher education programs in Bayelsa State.
- II. evaluate the impact of integrating an AI-Integrated Holistic Framework on the instructional strategies of teacher educators in diverse educational environments within Bayelsa State.

Research Questions

The following research questions guided the study:

- I. To what extent does the combination of theoretical knowledge, teaching skills, and AI technologies improve teacher education programs in Bayelsa State?

- II. What are the effects of using an AI-Integrated Holistic Framework in the teaching methods of teacher educators in different educational environments in Bayelsa State?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

Ho1: There is no significant difference in instructional effectiveness of traditional teacher education models and the AI-Integrated Holistic Framework in diverse educational settings in Bayelsa.

Ho2: There is no significant correlation between the traditional teacher education models and the AI-Integrated Holistic Framework aligned theoretical knowledge, practical teaching skills for teacher education in Bayelsa.

Methodology

This study utilized a descriptive survey research design, which combined qualitative and quantitative approaches in order to gain a comprehensive understanding of the impact of the AI-Integrated Holistic Framework on teacher education in Bayelsa. Bayelsa State consists of eight Local Government Areas, five notable tertiary institutions, one federal, three state, and one private institution. However, among these institutions, only four house a faculty of education. The population of the study consisted of 1055 individuals, including teacher educators and final year students, from these four institutions offering Teacher Education programmes. A simple random sampling technique was employed to select teacher education institutions, educators, and students within Bayelsa. The sample size was determined based on the identified institutions and the availability of participants who were willing to take part in the study. Out of the four institutions, two were randomly selected without replacement. From the population of 568 individuals, a sample size of 284, which represented 50% of the population, was used for the study.

The instrument used for data collection was the researchers' Structured Questionnaire titled "Quantitative Assessment of Perceived Impact of the AI-Integrated Holistic Framework on Instructional Effectiveness" (QAPIAHFIE). This questionnaire was designed to measure the extent to which the AI-Integrated Holistic Framework aligned with instructional effectiveness in teacher education in Bayelsa. The questionnaire utilized a four-point rating scale, ranging from Very Great Extent (VGE - 4 points), Great Extent (GE - 3 points), Low Extent (LE - 2 points), and Very Low Extent (VLE - 1 point). The instrument underwent face and content validity by three experts, two from the Department of Robotics and Computer Education at the University of Nigerian Nsukka and one from the Measurement and Evaluation unit of the Science Education Department, Federal University Otuoke, and Bayelsa State. The instrument was validated by three research experts. Reliability of the instrument was determined using Cronbach alpha statistic which yielded 0.82 and 0.84 for clusters 1 and 2 with an overall reliability index of 0.82. Out of the 284 copies of questionnaire distributed, 262 were returned representing 92.25% of the sample sizes. The collected data were analyzed using mean and standard deviation. Analysis of Variance (ANOVA) was employed to test the null hypotheses at a significance level of 0.05. The decision-making process was based on a criterion of 2.50. Mean scores of 2.50 and above were considered to indicate a great extent, while scores below 2.50 were considered to indicate a low extent.

Result

Research Question 1: To what extent does the combination of theoretical knowledge, teaching skills, and AI technologies improve teacher education programs in Bayelsa State?

Table 1: Summary of the mean rating provided by teacher educators regarding the Extent to which the Alignment of theoretical knowledge, practical teaching skills, and AI technologies will contribute to the overall improvement of teacher education programs in Bayelsa State

S/N	The alignment of theoretical knowledge, practical teaching skills, and AI-Integration Holistic framework in Bayelsa State will:	X	SD	Rmk
1.	Enable more cohesive teacher education in Bayelsa State	3.00	.82	GE
2.	Enhance an effective teacher education in Bayelsa State	2.97	.76	GE
3.	increase practical teaching skills, in of teacher educator	3.00	.84	GE
4.	Encourage enrollment of students into teacher education programmes	2.92	.80	GE
5.	improve the attitude of students in Institutions of teacher education positively	2.99	.84	GE
6.	Easy the work load of teacher educators	2.99	.79	GE
7.	make learning process within diverse educational environment more learner centered	3.02	.84	GE
8.	Encourage government to enforce the total adoption in teacher education in programmes	3.05	.83	GE
Grand Mean		2.99	.82	GE

The table indicates that teacher educators in Bayelsa State generally agree that aligning theoretical knowledge, practical teaching skills, and AI technologies will significantly enhance teacher education programs. The mean ratings, which range from 2.92 to 3.05, with a grand mean of 2.99, reflect a Great Extent (GE) on the positive impact of this alignment. The highest mean rating of 3.05 suggests that educators strongly believe that such alignment will encourage government enforcement of AI integration in teacher education. The results highlight a consensus on the benefits of integrating these elements to improve teacher education in Bayelsa State.

Research Question 2: What are the effects of using an AI-Integrated Holistic Framework in the teaching methods of teacher educators in different educational environments in Bayelsa State?

Table 2: Summary of the mean ratings provided by teacher educators the effects of using an AI-Integrated Holistic Framework in the teaching methods of teacher educators in different educational environments in Bayelsa State

S/N	The integration of the AI-Integrated Holistic Framework in teacher education in Bayelsa State will:	x	SD	Rmk
9.	Influence positively instructional strategies for diverse learning needs	3.00	.81	GE
10.	Ensure the customization of instructional strategies to cater for diverse learning needs?	3.01	.85	GE

11.	Increase effectiveness of instructional strategies.	3.02	.80	GE
12.	Will have less challenges in the full implementation	3.00	.81	GE
13	Create more job opportunities for teacher education outside Bayelsa State.	2.93	.79	GE
Grand Mean		2.99	.81	GE

Table 2 summarizes the mean ratings provided by teacher educators on the effects of using an AI-Integrated Holistic Framework in their teaching methods across various educational environments in Bayelsa State. The ratings indicate that the framework positively influences instructional strategies for diverse learning needs (Mean = 3.00, SD = 0.81) and ensures customization to cater to these needs (Mean = 3.01, SD = 0.85). It also increases the effectiveness of instructional strategies (Mean = 3.02, SD = 0.80) and faces fewer challenges in full implementation (Mean = 3.00, SD = 0.81). Additionally, the framework creates more job opportunities for teacher education outside Bayelsa State, although this effect is slightly lower (Mean = 2.93, SD = 0.79). The overall grand mean rating is 2.99 with a standard deviation of 0.81, indicating a generally Great Extent (GE).

Hypotheses 1: There is no significant difference in instructional effectiveness of traditional teacher education models and the AI-Integrated Holistic Framework in diverse educational settings in Bayelsa.

Table 3: Independent t-test value of the responses of teacher educator on instructional effectiveness of traditional teacher education models and the AI-Integrated Holistic Framework in diverse educational settings in Bayelsa

Group	n	\bar{x}	SD	df	P-value	Decision
Teacher educators	284	2.99	.82	283	1.10	Reject Ho

Table 3 presents the results of an independent t-test comparing the instructional effectiveness of traditional teacher education models and the AI-Integrated Holistic Framework in diverse educational settings in Bayelsa. With a mean score of 2.99 and a standard deviation of 0.82 for the responses from 284 teacher educators, the p-value of 1.10 leads to rejection of the null hypothesis (Ho), indicating a significant difference in instructional effectiveness between the two models. Therefore, the AI-Integrated Holistic Framework is perceived as more effective compared to traditional models.

Hypotheses 2: There is no significant correlation between the traditional teacher education models and the AI-Integrated Holistic Framework aligned theoretical knowledge, practical teaching skills for teacher education in Bayelsa

Table 4: Independent t-test value of the responses of teacher educator on instructional effectiveness of traditional teacher education models and the AI-Integrated Holistic Framework in diverse educational settings in Bayelsa

Group	n	\bar{x}	SD	df	P-value	Decision
Teacher Educator	284	2.99	.81	283	1.15	Reject Ho

Table 4 shows the independent t-test results for the correlation between traditional teacher education models and the AI-Integrated Holistic Framework regarding theoretical knowledge and practical teaching skills in Bayelsa. With a mean score of 2.99 and a standard deviation of 0.81 for 284 teacher educators, the p-value of 1.15 leads to the rejection of the null hypothesis (Ho), indicating a significant correlation between the two models. This implies that the AI-Integrated Holistic Framework aligns well with both theoretical knowledge and practical teaching skills compared to traditional models.

Discussions

The findings of the study showed that the AI-Integrated Holistic Framework played a significant role in enhancing instructional effectiveness for teacher education in diverse educational environments in Bayelsa State. This framework facilitated personalized learning experiences, allowing teachers to tailor their instruction to meet the unique needs of each student. Additionally, it provided real-time feedback and data analytics, enabling educators to make informed decisions and adjustments to their teaching strategies. The use of AI technology also fostered greater student engagement and motivation, as interactive and adaptive learning tools were incorporated into the classroom. The implementation of this framework significantly improved the quality of education and teaching outcomes in Bayelsa State.

The study conducted by Endurance, Ogbangain, and Jack (2014) supports the notion that AI-Integrated Holistic Frameworks can markedly improve instructional effectiveness within various educational settings. Their research highlights how integrating artificial intelligence into educational frameworks enhances teaching methodologies and learning outcomes across diverse environments. By leveraging AI technologies, educators can tailor instructional approaches to meet the specific needs of students, thereby fostering a more adaptive and effective learning experience. These findings underscore the transformative potential of AI in enhancing teacher education and instructional practices in contemporary educational environments.

Conclusion

The study initially highlights challenges in achieving AI integration in teacher education in Bayelsa State, the subsequent improvement in perceived effectiveness of instruction with AI integration holds promise. These findings underscored the dynamic nature of implementing educational technology and underline the need for strategic and collaborative efforts to ensure the successful integration of AI into the holistic framework for teacher education in diverse educational settings.

Recommendation

In view of the findings of the study, the following recommendations were proffered:

- I. To ensure long-term success, future iterations of the AI-Integrated Holistic Framework should leverage insights gained from the identified challenges. The provision of comprehensive training programs, establishment of support structures, and cultivation of an innovative culture can play a crucial role in overcoming initial resistance and facilitating successful integration of AI.
- II. The research underscores the significance of collaborative endeavors among educational stakeholders. Engaging educators, administrators, and policymakers in the decision-making process can foster a shared vision for the integration of AI, thereby nurturing a sense of ownership and dedication among stakeholders.

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