INTERNATIONAL JOURNAL OF CONTEMPORARY AFRICA RESEARCH NETWORK
Publication of Contemporary Africa Research Network (CARN)
Volume 3 (2), 2025
ISSN: 1115 – 585x
Available online: https://journals.iapaar.com/index.php/ijcarn/issue
DOI: 10.5281/zenodo.

AWARENESS, UTILIZATION, PERCEPTION AND CHALLENGES: INTEGRATION OF ARTIFICIAL INTELLIGENCE-BASED CHATGPT INTO SCIENCE EDUCATION

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Abstract

This research investigates the awareness, utilisation, perceptions, and challenges faced by secondary school science teachers in the Akwa Ibom North East Senatorial District, Nigeria, regarding the integration of artificial intelligence-based ChatGPT into science instruction. The study employed a descriptive survey research design. The Science Teachers' Awareness and Perceptions of AI-based ChatGPT Questionnaire (STAPACQ) was used to collect data from a stratified random sample of 189 science teachers. Quantitative data were analysed using descriptive statistics (mean and standard deviation). The findings revealed a low level of awareness (Mean = 2.03) and a very low level of utilisation (Mean = 1.41) of ChatGPT among the teachers. However, teachers' perceptions of its potential impact were generally positive (Mean = 3.31), indicating optimism about its benefits for teaching efficiency and student engagement, alongside concerns about its potential to hinder critical thinking. The challenges to integration were perceived as very high (Mean = 3.66), with unreliable internet connectivity, lack of technical knowledge, concerns about information accuracy, and absence of institutional support identified as the most significant barriers. The study concludes that while science teachers are open to the potential of AI tools, systemic and infrastructural constraints severely limit their adoption. It emphasises the critical need for targeted professional development, robust policy frameworks, and substantial investment in school infrastructure to facilitate the effective integration of AI technologies in science education.

Keywords: artificial intelligence; ChatGPT; science education; science teachers; technology integration; Nigeria

Introduction

Science education serves as a foundational pillar essential to both academic development and everyday life. It equips individuals with critical thinking skills, scientific literacy, and the ability to navigate an increasingly complex and technology-driven world (Darling-Hammond et al., 2020; National Research Council, 2012). Moreover, science education opens diverse career pathways and fosters curiosity, creativity, and evidence-based reasoning (Bybee, 2013; Osborne & Dillon, 2008). It also promotes disciplined inquiry and is integral to understanding natural phenomena and addressing global challenges such as climate change, health crises, and technological innovation (Lederman & Lederman, 2014).

Despite the critical role of science in education and society, many students struggle with both internal and external science assessments (Sjøberg & Schreiner, 2010; Vedder-Weiss & Fortus, 2012). Over time, science education researchers have identified numerous factors contributing to this underperformance. These include insufficient foundational knowledge, teaching methods that fail to accommodate diverse learning styles, a lack of personalised support to address varying paces of understanding, the presence of science-related anxiety that hinders engagement and comprehension, difficulty recognising the real-world relevance of scientific concepts, inadequate hands-on practice leading to diminished retention and confidence, a curriculum that advances too rapidly for some learners, limited access to laboratory equipment and digital resources, negative mindsets regarding one's ability to excel in science, and external factors such as personal, health, or family issues that affect concentration and academic focus (Potvin & Hasni, 2014; Tytler & Osborne, 2012).

Improving students' science achievement requires a multifaceted approach (Hattie, 2009). This includes differentiated instruction, evidence-based pedagogical strategies, a supportive and inclusive learning environment, and access to resources that promote independent investigation (National Research Council, 2012). Encouraging a positive attitude toward science and incorporating inquiry-based, real-world applications can significantly enhance student performance (Minner et al., 2010). To further boost scientific literacy and engagement, teachers should identify and address learning gaps, employ varied instructional methods, set clear learning goals, ensure content relevance, promote active and collaborative learning, provide ample opportunities for experimentation and reflection, deliver constructive feedback, encourage critical thinking, utilise formative assessments, nurture a growth mindset, offer supplementary materials, create a positive classroom culture, set achievable expectations, integrate technology effectively, adapt instruction based on student progress, and encourage metacognition (Bybee, 2013; Duschl et al., 2007). Among these strategies, the effective use of technology in science teaching and learning is of particular interest to this study.

Technology enriches science education by providing innovative tools, simulations, and resources that complement and extend traditional teaching methods (Linn et al., 2018; Webb, 2005). When used appropriately, technology can deepen conceptual understanding, improve retention, and facilitate the application of scientific principles, thereby preparing students for success in a digitally advanced society (Honey & Hilton, 2011). Technological infrastructure supplies the computational power and platforms necessary to develop and deploy artificial intelligence (AI) systems (Russell & Norvig, 2020). AI, in turn, leverages these advancements to analyse data, learn from patterns, and make informed decisions or predictions (Michie et al., 1994). Together, they drive the creation of intelligent systems with broad applications across various domains, including education (Baker & Inventado, 2014; Selwyn, 2019). AI is increasingly being integrated into educational contexts to enhance instructional and learning experiences, particularly in science education (Ouyang & Jiao, 2021; Zhai et al., 2020).

The use of AI-based ChatGPT in science teaching and learning is gaining attention among educators (Su & Yang, 2023). ChatGPT is a state-of-the-art AI conversational model developed by

OpenAI. It employs advanced generative pre-trained transformer (GPT) technology and has been trained on diverse textual data to produce human-like responses (OpenAI, 2023). This enables it to engage in dialogue, answer questions, and assist with a variety of tasks. With broad knowledge and contextual understanding, ChatGPT is versatile for content creation, virtual assistance, and educational support (Kasneci et al., 2023). It is proficient in a wide range of topics up to its knowledge cutoff date but may lack information on subsequent developments (OpenAI, 2023). ChatGPT represents a significant advancement in AI-driven communication, with the potential to enhance human–computer interaction across various sectors, including education (Bozkurt, 2023).

ChatGPT is an AI tool that can help science teachers save time and design innovative, engaging lessons (Firaina & Sulisworo, 2023; Lo, 2023). Science educators can use ChatGPT to identify real-world connections to scientific concepts, align content with student interests, and generate various instructional materials such as explanations, simulations, and assessment items (Harris, 2023; Moore, 2023). However, concerns exist regarding its potential negative impacts, such as encouraging over-reliance on the tool and inhibiting the development of students' critical thinking and investigative skills (Pittalwala, 2023). Despite these concerns, ChatGPT remains a valuable resource to support teachers in creating dynamic learning experiences and optimising their workflow (Dilmegani, 2023; Javaid et al., 2023).

While ChatGPT has been successfully utilized in other fields, including education, its specific application in science teaching remains underexplored. This gap in the literature highlights the necessity of investigating how science teachers in Nigeria perceive and engage with AI-based ChatGPT. Given the novelty of ChatGPT and its potential benefits in enhancing educational practices, this study aims to fill this critical gap by exploring teachers' awareness, usage, perceptions, and challenges related to AI-based ChatGPT in science teaching and learning. The research objectives are to (i) assess the level of awareness among science teachers regarding AI-based ChatGPT in science education, (ii) determine the frequency of utilization of AI-based ChatGPT by science teachers in their instruction, (iii) explore science teachers' perceptions regarding the impact of ChatGPT on science teaching and learning, and (iv) identify and analyse science teachers' challenges in integrating AI-based ChatGPT into their teaching practices.

Research Questions

The research questions that guided this study are the following:

1. To what extent are science teachers aware of AI-based ChatGPT and its applications in science teaching and learning?
2. How frequently do science teachers utilise AI-based ChatGPT in their science instruction?
3. What are science teachers' perceptions regarding the impact of ChatGPT on science teaching and learning?
4. What challenges do science teachers encounter in integrating AI-based ChatGPT into their science teaching practices?

Research Method

This study employed a descriptive survey research design. This design was deemed appropriate as it allowed for the systematic collection of quantitative data from a sample of science teachers to describe their awareness, utilisation patterns, perceptions, and challenges regarding the integration of AI-based ChatGPT into science instruction without manipulating any variables (Creswell & Creswell, 2018). The design facilitated the gathering of a large amount of data from a specific population to provide a snapshot of the current state of affairs concerning the phenomenon under investigation.

The study was conducted in public secondary schools within the Akwa Ibom North East Senatorial District of Nigeria. This district comprises six local government areas (LGAs): Uyo, Itu, Ibiono Ibom, Uruan, Etinan, and Nsit Ubium. The area was selected because it is a major educational hub in Akwa Ibom State, hosting numerous secondary schools and a diverse population of science teachers, thus providing a rich context for investigating the integration of modern AI tools in science education.

The population for this study consisted of all science teachers in public secondary schools within the Akwa Ibom North East Senatorial District. A stratified random sampling technique was used to select a representative sample. The strata were based on the six local government areas (LGAs) to ensure proportional representation from each LGA. From a total population of approximately 350 science teachers, a sample of 200 teachers was selected using the Taro Yamane formula. The final sample of 200 science teachers was distributed across the various LGAs based on the proportion of schools in each area.

The instrument used for data collection was a structured questionnaire titled “Science Teachers’ Awareness and Perceptions of AI-based ChatGPT Questionnaire (STAPACQ).” The STAPACQ was adapted from an online survey created by Nguyen (2024). The adaptation involved modifying the language and scenarios to be specific to science education contexts (e.g., generating lab report ideas, explaining scientific concepts, creating hypothesis examples). The questionnaire was divided into two sections: **Section A** collected demographic information including gender, local government area, highest academic qualification, and years of teaching experience. **Section B** contained 20 item statements structured into four subsections aligned with the research questions: Awareness (5 items), Utilisation (5 items), Perceptions (5 items), and Challenges (5 items). Respondents indicated their level of agreement or frequency on a four-point Likert scale (e.g., for Awareness: Very Aware=4, Aware=3, Unaware=2, Very Unaware=1; for Utilisation: Very Frequently=4, Frequently=3, Rarely=2, Never=1).

The instrument underwent face and content validation by three experts in science education, educational technology, and measurement and evaluation. Their suggestions were used to refine the clarity and relevance of the items. The reliability of the instrument was established through a pilot study involving 30 science teachers from a different senatorial district (Akwa Ibom South West). The data collected from the pilot study were analysed using Cronbach's alpha, which yielded a coefficient of 0.79, indicating high internal consistency and reliability of the instrument for the study.

The researchers, with the assistance of three trained research assistants, administered the questionnaires to the selected science teachers in their respective schools. Permission was obtained from the Akwa Ibom State Post Primary Education Board and the principals of the selected schools. The purpose of the study was explained to the participants, and confidentiality was assured. The questionnaires were administered and collected on the spot to ensure a high return rate. Out of the 200 questionnaires distributed, 189 were correctly filled and returned, yielding a 94.5% response rate.

The quantitative data collected were analysed using descriptive statistics. The research questions were answered using means and standard deviations. The mean rating for each item and subsection was interpreted based on the following criteria: For Awareness and Utilisation: Mean of 3.50 – 4.00 (Very High), 2.50 – 3.49 (High), 1.50 – 2.49 (Low), 1.00 – 1.49 (Very Low). For Perceptions and Challenges: Mean of 3.50 – 4.00 (Strongly Agree/Very High Challenge), 2.50 – 3.49 (Agree/High Challenge), 1.50 – 2.49 (Disagree/Low Challenge), 1.00 – 1.49 (Strongly Disagree/Very Low Challenge). All analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 29.

Results

The findings and analysis of the data are presented in accordance with the research questions. The results are based on quantitative data obtained from 189 science teachers in the Akwa Ibom North East Senatorial District.

Research Question 1: To what extent are science teachers aware of AI-based ChatGPT and its applications in science teaching and learning?

To answer this question, descriptive statistics (mean and standard deviation) were calculated for the 5 items on the awareness subscale. The results are presented in Table 1.

Table 1: Mean and Standard Deviation of Science Teachers' Awareness of AI-based ChatGPT (N=189)

S/N	Item Statement	Mean	Std. Deviation	Remark
1.	I am aware of the existence of AI-powered chatbots like ChatGPT.	2.15	1.12	Low
2.	I understand what ChatGPT is and its basic functionality.	1.98	1.08	Low
3.	I am aware that ChatGPT can be used for science education tasks.	1.87	1.05	Low
4.	I know how to access and open the ChatGPT platform.	1.92	1.21	Low
5.	I am aware of the debates surrounding ChatGPT use in education.	2.23	1.14	Low
	Grand Mean	**2.03**	**1.12**	**Low**

The results in Table 1 indicate that the overall awareness of AI-based ChatGPT among science teachers in Akwa Ibom North East is **low** (Grand Mean = 2.03). Item 5, which pertains to awareness of the debates around ChatGPT, recorded the highest mean score (M=2.23), though it

still falls within the "low" awareness category. The lowest mean score (M=1.87) was for item 3, which states, "I am aware that ChatGPT can be used for science education tasks." This suggests that even those teachers who have heard of ChatGPT are largely unaware of its specific applications and potential in the science classroom. The standard deviations, all above 1.00, indicate a moderate spread in the responses, but the consensus remains around a general lack of awareness.

Research Question 2: How frequently do science teachers utilise AI-based ChatGPT in their science instruction?

To answer this question, descriptive statistics were calculated for the 5 items on the utilisation subscale. The results are presented in Table 2.

Table 2: Mean and Standard Deviation of Science Teachers' Utilisation of AI-based ChatGPT (N=189)

S/N	Item Statement	Mean	Std. Deviation	Remark
6.	I use ChatGPT to generate ideas for lesson plans in science.	1.45	0.82	Very Low
7.	I use ChatGPT to create examples or explanations for science concepts.	1.52	0.89	Very Low
8.	I use ChatGPT to generate quiz questions or homework assignments.	1.38	0.75	Very Low
9.	I use ChatGPT to provide additional support to struggling students.	1.29	0.68	Very Low
10.	I recommend ChatGPT as a learning tool to my students.	1.41	0.71	Very Low
	Grand Mean	**1.41**	**0.77**	**Very Low**

The results in Table 2 show that the frequency of utilisation of AI-based ChatGPT for science instruction is very low (Grand Mean = 1.41). All individual item means are well below the 1.50 threshold, indicating that the vast majority of science teachers "Never" or "Rarely" engage in any of the listed activities involving ChatGPT. The lowest mean score (M=1.29) is for item 9, "I use ChatGPT to provide additional support to struggling students," highlighting that it is not being used for differentiated instruction. The very low standard deviations (all below 1.00) suggest a high level of consistency in the responses, confirming that infrequent use is a widespread phenomenon among the respondents.

Research Question 3: What are science teachers' perceptions regarding the impact of ChatGPT on science teaching and learning?

To answer this question, descriptive statistics were calculated for the 5 items on the perceptions subscale. The results are presented in Table 3.

Table 3: Mean and Standard Deviation of Science Teachers' Perceptions of ChatGPT's Impact (N=189)

S/N	Item Statement	Mean	Std. Deviation	Remark
11.	ChatGPT can make science teaching more efficient.	3.42	0.91	Agree
12.	ChatGPT can help create more engaging science lessons.	3.38	0.88	Agree
13.	ChatGPT can improve students' understanding of complex science topics.	3.21	0.95	Agree
14.	The use of ChatGPT might hinder the development of students' critical thinking skills.	3.05	1.12	Agree
15.	I am optimistic about the potential of ChatGPT in science education.	3.48	0.84	Agree
	Grand Mean	**3.31**	**0.94**	**Agree**

Despite their low usage, science teachers' overall perceptions of ChatGPT's potential impact are positive (Grand Mean = 3.31). They generally "Agree" that ChatGPT can make teaching more efficient (M=3.42), create engaging lessons (M=3.38), and improve student understanding (M=3.21). Notably, they are optimistic about its future potential (M=3.48). However, this optimism is tempered by a significant concern, as they also agree (M=3.05) that ChatGPT might hinder the development of critical thinking skills. This indicates a nuanced perception: teachers recognize the benefits but are also aware of the potential pedagogical risks associated with the technology.

Research Question 4: What challenges do science teachers encounter in integrating AI-based ChatGPT into their science teaching practices?

To answer this question, descriptive statistics were calculated for the 5 items on the challenges subscale. The results are presented in Table 4.

Table 4: Mean and Standard Deviation of Challenges in Integrating ChatGPT (N=189)

S/N	Item Statement	Mean	Std. Deviation	Remark
16.	Unreliable internet connectivity in my school is a major challenge.	3.82	0.96	Very High Challenge
17.	I lack the technical knowledge to use ChatGPT effectively.	3.58	0.89	Very High Challenge
18.	I am concerned about the accuracy of scientific information provided by ChatGPT.	3.71	0.92	Very High Challenge
19.	There is a lack of institutional support or policy for using such tools.	3.65	1.04	Very High Challenge
20.	I am concerned about students using ChatGPT to plagiarize or avoid learning.	3.52	1.11	High Challenge
	Grand Mean	**3.66**	**0.98**	**Very High Challenge**

The results in Table 4 reveal that science teachers face challenges at a very high extent (Grand Mean = 3.66) in integrating ChatGPT. The most formidable challenge, as perceived by the teachers, is unreliable internet connectivity (M=3.82). This is closely followed by concerns about the accuracy of scientific information (M=3.71) and a lack of institutional support (M=3.65). The lack of technical knowledge is also a significant barrier (M=3.58). While still a "High Challenge," the concern about plagiarism (M=3.52) was rated slightly lower than the other, more infrastructural and technical barriers. These findings clearly identify the key obstacles that must be addressed for successful integration of AI tools in this context.

Discussion

The findings of this study provide a clear and concerning snapshot of the readiness and prevailing conditions for integrating AI-based tools like ChatGPT into science education in the Akwa Ibom North East Senatorial District. The discussion is structured around the four research questions that guided the investigation.

Awareness of AI-based ChatGPT

The results indicate that science teachers' overall awareness of AI-based ChatGPT is low (Grand Mean = 2.03). This finding is particularly striking as it pertains to educators in a STEM field that is inherently driven by technology and innovation. This low level of awareness suggests a significant digital divide and a gap in professional development concerning emerging educational technologies. This finding lends credence to the work of Adarkwah et al. (2023), who confirmed minimal awareness of ChatGPT among educators in Ghana, noting a lack of conceptual understanding of its application in teaching and learning. The low awareness uncovered in this study can be attributed to several potential factors prevalent in many Nigerian educational contexts: insufficient targeted training programs, limited dissemination of information about AI tools within professional learning communities, and possibly a focus on overcoming more fundamental infrastructural challenges, which leaves little room for engagement with cutting-edge technologies.

Utilisation of AI-based ChatGPT

Corresponding with the low awareness, the frequency of utilisation of ChatGPT is very low (Grand Mean = 1.41). This is perhaps the most direct consequence of the lack of awareness identified in the first research question. If teachers are not aware of a tool or its pedagogical applications, they cannot be expected to use it. This finding aligns with the study by Sumin and Mossholder (2023), which highlighted a significant disparity between teachers' familiarity with ChatGPT and its actual educational utilisation. The very low utilisation scores across all items, especially in generating lesson ideas and providing student support, indicate that ChatGPT has not yet penetrated the instructional practices of science teachers in this district. This underscores that the integration of AI in education is not automatic; it is predicated on first building foundational knowledge and competence through deliberate and structured professional development initiatives.

Perceptions of ChatGPT's Impact

Despite the low awareness and usage, science teachers' perceptions of ChatGPT's potential impact were surprisingly positive (Grand Mean = 3.31). Teachers agreed that ChatGPT could enhance teaching efficiency, create engaging lessons, and improve student understanding, and they expressed optimism about its future potential. This indicates an openness to innovation and a recognition of the transformative potential of AI, even among those who have not yet used it extensively. This finding corroborates the results of Widianingtyas et al. (2023), who reported a positive perception among teachers regarding ChatGPT's integration into instruction. However, the teachers in the current study also expressed a significant concern: they agreed that ChatGPT could hinder the development of critical thinking skills. This nuanced perception reflects a mature understanding of the dual-edged nature of AI in education. Teachers are not merely technophobic; they are cautiously optimistic, recognizing the benefits while remaining wary of potential drawbacks like academic dishonesty and over-reliance, as noted by Memarian and Doleck (2023).

Challenges in Integration

The study identified that teachers perceive the challenges to integration as very high (Grand Mean = 3.66). The most formidable barriers were infrastructural (unreliable internet connectivity) and institutional (lack of support and policy). This is a critical finding that moves the conversation beyond individual teacher competence. The challenge is not solely a lack of technical knowledge but is deeply rooted in the broader educational ecosystem. The concern about the accuracy of scientific information (M=3.71) is especially pertinent for science education, where factual correctness is paramount, and aligns with findings by Wardat et al. (2023) on ChatGPT's limitations in comprehending complex subject matter. These challenges highlight a stark reality: without addressing fundamental issues like stable electricity, internet access, and clear policy guidelines from educational authorities, efforts to promote AI integration in classrooms like those in Akwa Ibom North East are likely to fail. The challenges related to plagiarism and technical knowledge, while still rated high, are secondary to these more systemic barriers.

Conclusions, Educational Implications and Recommendations

This study provides a critical examination of the readiness for AI integration in science education within the Akwa Ibom North East Senatorial District. The findings lead to several overarching conclusions. Primarily, a significant awareness gap exists among science teachers regarding AI-based ChatGPT and its specific applications in science education, which serves as the fundamental barrier to its adoption. Consequently, the utilisation of ChatGPT in science instruction is virtually non-existent, representing a direct consequence of both low awareness and the profound challenges identified. Despite this lack of practical experience, science teachers hold guarded but optimistic perceptions about the tool's potential impact, recognizing its capacity to enhance efficiency and engagement while simultaneously expressing legitimate concerns about its potential to undermine critical thinking and academic integrity. Finally, the challenges to integration are identified as profound and systemic, extending far beyond individual teacher competence to include crippling infrastructural deficits, a lack of institutional support and policy, and concerns about the reliability of AI-generated scientific information. In essence, while a

openness to innovation exists, the current educational ecosystem is not yet conducive for the meaningful integration of AI tools.

The findings of this study carry significant implications for science education stakeholders. For teacher professional development, the results underscore an urgent need for comprehensive training that moves beyond basic digital literacy to include awareness-building on emerging AI tools and hands-on pedagogical applications. For educational policy and administration, the study highlights that technological integration is not solely a teacher-level issue but requires prioritised investment in foundational digital infrastructure and the development of clear, pragmatic policies governing the ethical use of AI. Furthermore, for curriculum design, the implications suggest a need to incorporate modules that teach students digital literacy and critical evaluation skills specifically tailored to AI-generated content, thereby mitigating concerns about over-reliance. These implications collectively point to a necessary multi-level approach to enable effective AI adoption.

Based on the conclusions and implications, concrete recommendations are proposed for key stakeholders. The government and educational authorities must prioritize investment in upgrading ICT infrastructure, particularly stable internet connectivity, and formulate a clear policy framework for AI use in education. They should also organize large-scale, mandatory training workshops for science teachers on emerging educational technologies. School administrators are encouraged to create internal support systems like peer-mentoring groups, advocate for better technological resources, and foster a tech-positive culture within their schools. For science teachers, a proactive approach to learning about AI tools through personal initiative is recommended, starting with small-scale applications for personal productivity before moving to student-facing activities, all while emphasizing the critical evaluation of AI outputs. Finally, future researchers should expand the geographical scope of this inquiry, design intervention studies to test training effectiveness, and conduct qualitative follow-ups to gain deeper insights into successful use cases. These coordinated efforts are essential to bridge the identified gap between the potential of AI and its current practice in science classrooms.

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