

Teachers' Awareness and Perception on Utilization of Artificial Intelligence as a Tools for Teaching and Learning of Chemistry at Secondary Schools in Sokoto State

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Abstract

The integration of Artificial Intelligence (AI) in education, particularly in science subjects like chemistry, has emerged as a transformative force, offering personalized learning, simulations, and real-time feedback. Despite its potential, the adoption of AI tools in secondary schools, especially in Sokoto State, Nigeria, remains limited due to factors such as lack of awareness, inadequate infrastructure, and insufficient teacher training. This study examined secondary school chemistry teachers' awareness and perceptions of AI utilization for teaching and learning chemistry in Sokoto State. A descriptive research design was employed, with a sample of 160 teachers from Sokoto Metropolis. Data were collected using a structured questionnaire and analyzed through descriptive statistics. Findings revealed a low level of teachers' awareness regarding AI tools in chemistry education, with most teachers lacking familiarity with AI applications in their teaching. However, the perception of AI's potential benefits was generally positive, with teachers recognizing the value of AI in enhancing student engagement and offering individualized learning experiences. The study highlights the need for targeted professional development programs to improve teachers' understanding and application of AI in chemistry education. This research contributes to the broader discourse on AI's role in education, particularly in resource-constrained regions like Sokoto State, and provides insights for policy and practice to optimize the use of AI in classrooms.

Keywords: Artificial Intelligence, Awareness, Perception, Chemistry, Teachers

Introduction

In recent years, the global education system has increasingly adopted artificial intelligence (AI) tools to improve the effectiveness of teaching and learning. For example, AIs embedded in curriculum development, adaptive learning platforms and virtual laboratories, providing educators with the opportunity to attract students in a more interactive and immersive way (Kukulska-Hulme, 2020). AI is generally believed that artificial intelligence could revolutionize the way we learn and teach, there are still some lapses in teachers and students showing ineffective and negative attitudes towards the usefulness and application of artificial intelligence to make it more personalized, engaging and efficient (Nedjah, & Johnson, 2019;

Hutchins, 2021; Kautz, Etzioni, & Mooney 2021 Akgun, & Greenhow, 2022). This can be visualized in many academic environments evolving from lack of trust, cost, and unwillingness to use effective technical tools to promote learning and instruction on the teacher as well as the learner side, artificial intelligence has emerged as an element of change in various industries, and the way we teach and learn, and its impact on chemistry as a learning course at secondary and tertiary levels is undeniable (Binns, 2017; Aguolu, 2019; & Flavian & Casalo, 2021). The context of AI in teaching and learning chemistry was based on a theoretical framework is essential for guiding the investigation of teachers' awareness and perception of AI tools in the context of teaching and learning chemistry in Nigerian secondary schools. The theoretical framework provides a foundation for understanding the relationship between teachers' awareness, their perceptions, and the integration of AI in education. The relevant theory is Technology Acceptance Model (TAM) proposed by Davis (1989), is one of the most widely applied models for understanding the factors that influence the adoption and use of technology in educational settings. TAM posits that Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) are key determinants of technology acceptance.

Perceived Usefulness (PU): This refers to the degree to which a teacher believes that using AI tools would enhance the quality of teaching and improve learning outcomes in chemistry. Teachers may perceive AI tools as useful if they assist in better explaining complex chemical concepts, providing interactive simulations, or offering personalized learning experiences for students.

Perceived Ease of Use (PEOU): This refers to how easy teachers believe it is to use AI tools in the classroom. If AI tools are complex, require extensive training, or need high-end infrastructure, teachers may be hesitant to adopt them.

The integration of AI into education most particularly science education is emerging as a transformative platform that improves, teaching and learning in schools. The AI technology has shown significant prospects in various fields science education, referencing to chemistry in this context. Part of these promising prospects include personalized learning, and simulation of complex chemical reactions, real-time assessment and feedback. Olaogun and Oyediran (2023) explored how AI is rapidly transforming various aspects of society, including education. The study involved 74 educators and utilized the

Opinion Scale on Artificial Intelligence in Education to gather valuable insights. The research outcomes reveal a predominantly favourable view of AI in education. The study contributes significantly to the ongoing discourse on the role of AI in education, emphasizing the necessity for a balanced approach that maximizes the benefits of AI while ensuring the protection of the rights and interests of all stakeholders. Furthermore, Sun, Yang and Chen (2021) documented that AI for chemistry education can provide virtualized chemistry laboratories, simulation tools, and artificial intelligence-oriented platforms to help simplify complex concepts of molecular structure, reactions, and chemical equations. However, these benefits are often hampered by gaps in infrastructure and teacher preparation, especially in underdeveloped nation with less infrastructural development in classrooms.

Despite these significance of AI for a more personalized, engaging and efficient, it is revealed that there are still some lapses with regards to the teachers' utilization of artificial intelligence. AI models like Large Language Models, has shown substantial potential in generating educational content. However, this technology's rapid rise has brought forth ethical concerns regarding general and educational use that require careful attention from educators. The UNESCO framework on GenAI in education provides a comprehensive guide to controversies around generative AI and ethical educational considerations, emphasizing human agency, inclusion, equity, and cultural diversity (Blonder & Feldman-Maggor, 2024). This development could be as a result of their level of awareness and readiness toward its full integration (Amoah, Osei, & Kwame, 2020 and Olatunji, Adebayo, & Lawal, 2022). Efforts have constantly been made to incorporate AI into teaching and learning; however, the successful implementation of new instructional technologies is closely related to the attitudes of the teachers who lead the lesson. Teachers' perceptions of AI utilization have only been investigated by only few scholars which indicated an overall lack of experience of teachers regarding how AI can be utilized in the classroom as well as no specific idea of what AI-adopted tools would be like. This is evidenced by Adebayo (2023) that in Nigeria, the government is making efforts to incorporate Information and Communication Technology into education, but the degree of adoption of AI in secondary schools, mainly in Sokoto state, is unknown. The state faces a unique set of challenges, including limited internet connectivity, lack of modern educational facilities, and insufficient professional development opportunities for teachers. These factors

greatly affect the way chemistry teachers access and apply AI tools in the classroom.

In support of the above, a study carried out Kim and Kim (2022) investigated how teachers perceived an AI-enhanced scaffolding system developed to support students' scientific writing for STEM education. Results revealed that most STEM teachers positively experienced AI as a source for superior scaffolding. On the other hand, they also raised the possibility of several issues caused by using AI such as the change in the role played by the teachers in the classroom and the transparency of the decisions made by the AI system. These results can be used as a foundation for which to create guidelines for the future integration of AI with STEM education in schools, since it reports teachers' experiences utilizing the system and various considerations regarding its implementation. Furthermore, Güneşli, Burgul, Dericioğlu, Cenkova, Becan, Şimşek, and Güneralp (2024) investigated the level of awareness among teachers regarding the use of AI in education, focusing on whether this awareness varies according to socio-demographic characteristics, access to technology, and specific knowledge and beliefs about AI. Conducted in Northern Cyprus during the 2023–2024 academic year, this study employed a survey model with purposive and snowball sampling methods, involving 164 teachers. Teachers at different levels, namely, primary school, secondary school, high school, and university, were included in this study. This study explored the distribution of AI use across different school types and educational levels and assessed the impact of sub-dimensions of AI awareness on its application in teaching. Findings revealed low level AI awareness among teacher most particularly at primary and secondary levels of education. However, usage patterns indicated that university lecturers were more likely to incorporate AI in their teaching, followed by primary and high school teachers, with secondary school teachers using it the least. These results highlight the importance of practical knowledge for fostering AI integration in educational practices, underscoring significant implications for teacher training and professional development programs.

Statement of the Problem

Regardless of the utmost utilization of AI in enhancing the delivery of chemistry concepts which has undeniably captivate several individuals' attention and generate various opinions on AI vary because some teachers are not fully aware of how and where this tool

could be accessed and even be applied to guide their classroom instructions. In Sokoto State, the research is not clear about teachers' beliefs on whether AI can assist them in overcoming several challenges and expedite processes of teaching and learning of chemistry concepts. Hence, this study examined teachers' awareness and perception on utilization of artificial intelligence as a tools for teaching and learning of chemistry at secondary schools.

Objectives of the Study

This study examined teachers' awareness and perception on utilization of artificial intelligence as a tool for teaching and learning of chemistry at secondary schools in Sokoto state. More specifically, the study examined the level of:

1. teachers' awareness on utilization of artificial intelligence as a tool for teaching and learning of chemistry at secondary schools in Sokoto State
2. teachers' perception on utilization of artificial intelligence as a tool for teaching and learning of chemistry at secondary schools in Sokoto State.

Research Questions

The following research question were responded to by the research:

1. What is the level teachers' awareness on utilization of artificial intelligence as a tool for teaching and learning of chemistry at secondary schools in Sokoto State?
2. What is the level teachers' perception on utilization of artificial intelligence as a tool for teaching and learning of chemistry at secondary schools in Sokoto State?

Methodology

This study examined the level of teachers' awareness and perception on the utilization of artificial intelligence as a tools for teaching and learning of chemistry at secondary schools in Sokoto state. It aimed to describe teachers' awareness and perceptions on utilization of AI as a tool for teaching and learning of chemistry at secondary schools. Hence, it employed descriptive research design. A sample of 165 was randomly selected from the population of 288 teachers in the Sokoto Metropolis. The instrument for data collection was Teachers' Awareness and Perception Questionnaire (TAPQ) structured in the form of four point likert scale designed by the researcher, validated by

two experts in the field of Chemistry Education. After a pilot testing, a reliability coefficient of 0.68 was obtained. During data collection, 165 questionnaires were distributed but 160 were retrieved properly filled by the respondents. The data collected were analyzed using descriptive statistical analysis of simple percentage of frequency and average mean. A benchmark mean point of 2.50 was regarded as acceptable level of agreement. Therefore a mean score of less than 2.50 indicated that the respondents disagrees with the statement and a mean score of 2.50 and above shows that the respondents agrees with the statement.

Table 1: Teachers' Awareness on Utilization of Artificial Intelligence

S/N	Items	SA (%)	A (%)	D (%)	SD (%)	Mean	Decision
1	The concept of Artificial Intelligence is well familiar to me	20(12.5.2)	32(20)	45(28.1)	63(39.4)	2.05	Disagree
2	I understand how Artificial Intelligence is utilized in the teaching and learning of chemistry	19(11.8)	30(18.8)	37(23.1)	74(46.3)	1.96	Disagree
3	I am acquainted with how Artificial Intelligence is utilized in teaching and learning of chemistry	23(14.4)	36.(22.5)	31(19.4)	70(43.8)	2.08	Disagree
4	I am familiar of the potential benefits chemistry teachers would gained when they used artificial intelligence	11(6.9)	38(23.8)	37(23.1)	74(46.3)	1.91	Disagree
5	I'm conversant with the simulation in Artificial Intelligence as a tool used for teaching and learning chemistry	10(6.3)	9(5.6)	67(41.9)	74(46.3)	1.72	Disagree
6	I came across how Artificial Intelligence can aid in chemistry problem solving	31(19.4)	70(43.8)	23(14.4)	36.(22.5)	2.60	Agree
7	I attended relevant trainings on how to integrate Artificial Intelligence in the teaching and learning of in chemistry	10(6.3)	9(5.6)	67(41.9)	74(46.3)	1.72	Disagree

Table 1 indicated that the respondents disagrees with all the items except item 5 that "I'm conversant with the simulation in Artificial Intelligence as a tool used for teaching and learning chemistry". The result shows a mean score that is less than the benchmark mean point of 2.50 that was regarded as acceptable level with the exception of item5 that a mean score of 2.60 which is greater than 2.50. This revealed that the level of teachers' awareness on utilization of AI as a tools for teaching and learning of chemistry at secondary schools in

Sokoto State is low, indicating that most of the teachers are not fully aware on how utilize AI as a tools for teaching and learning of chemistry at secondary schools.

Table 2: Teachers' Perception on Utilization of Artificial Intelligence

S/N	Items	SA (%)	A (%)	D (%)	SD (%)	Mean	Decision
1	Learning chemistry can be made more engaging for students by Artificial Intelligence	33(28.1)	63(39.4)	28(12.5.2)	32(20)	2.56	Agree
2	Virtual labs and simulations are examples of AI tools that can aid students in comprehending difficult chemistry concepts	34(21.3)	58(36.3)	23(14.4)	45(28.2)	2.51	Agree
3	Artificial intelligence (AI) can help students in chemistry to have a more individualized learning experience	33(20.6)	60(37.5)	23(14.4)	44(27.5)	2.51	Agree
4	Artificial intelligence (AI) can assist chemistry learners have a more individualized and personalized learning experience	31(19.4)	70(43.8)	23(14.4)	36.(22.5)	2.60	Agree
5	Chemistry teachers need a lot of help to use AI tools because they are too complex	36(22.5)	70(43.8)	23(14.4)	31.(19.4)	2.70	Agree
6	Artificial Intelligence based chemistry tools are difficult to be used in chemistry instruction	83(51.9)	52(32.5)	19(11.8)	6(3.8)	3.33	Agree
7	Artificial Intelligence sometimes provide inaccurate or irrelevant recommendation which make it not easy for chemistry teachers to take decision	20(12.5.2)	32(20)	45(28.1)	63(39.4)	2.05	Disagree

Table 2 indicated that the respondents agrees with all the items exception of item 7 that “Artificial Intelligence sometimes provide inaccurate or irrelevant recommendation which make it not easy for chemistry teachers to take decision”. It shows a mean score that is greater than the benchmark mean point of 2.50 that was regarded as acceptable level with the exception of item 7 that a mean score of 2.05 which is less than 2.50. This revealed that the level of teachers' perception on utilization of AI as a tools for teaching and learning of chemistry at secondary schools in Sokoto State is positive, indicating that most of the teachers positively perceived the usefulness and ease

of use of AI as a tools for teaching and learning of chemistry at secondary school.

Discussion

The discussions of the findings were done based on the objectives of the study. The first finding indicated that there is low level of teachers' awareness on utilization of AI as a tools for teaching and learning of chemistry at secondary schools in Sokoto state. This finding is in line with that of Güneşli, Burgul, Dericioğlu, Cenkova, Becan, Şimşek, and Güneralp (2024) who investigated the level of awareness among teachers regarding the use of AI in education in Northern Cyprus, focusing on whether this awareness varies according to socio-demographic characteristics, access to technology, and specific knowledge and beliefs about AI. Their Findings revealed low level AI awareness among teacher most particularly at primary and secondary levels of education. However, usage patterns indicated that university lecturers were more likely to incorporate AI in their teaching, followed by primary and high school teachers, with secondary school teachers using it the least. These results highlight the importance of practical knowledge for fostering AI integration in educational practices, underscoring significant implications for teacher training and professional development programs.

Secondly, the findings revealed positive perception among teachers on the utilization of artificial intelligence as a tools for teaching and learning of chemistry at secondary schools in Sokoto State is positive. This finding coincides with the finding of a study carried out by Kim and Kim (2022) investigated how teachers perceived an AI-enhanced scaffolding system developed to support students' scientific writing for STEM education. Results revealed that most STEM teachers positively experienced AI as a source for superior scaffolding. On the other hand, they also raised the possibility of several issues caused by using AI such as the change in the role played by the teachers in the classroom and the transparency of the decisions made by the AI system.

Conclusion

In conclusion, the integration of AI into secondary school chemistry education in Sokoto State has shown promising potential but also significant challenges. The findings indicate that there is a low level of teachers' awareness regarding AI as a tool for teaching and learning, despite its potential to enhance student engagement, provide

personalized learning experiences, and improve the understanding of complex chemistry concepts. This aligns with studies in other regions where AI awareness and usage are similarly limited, especially in resource-constrained environments. However, teachers' perceptions of AI were largely positive, highlighting the potential of AI to make chemistry education more engaging and individualized. This suggests that while teachers may be open to AI, they face barriers in accessing adequate training, resources, and infrastructure.

The study underscores the need for targeted professional development programs that enhance teachers' awareness and skills in utilizing AI effectively. Additionally, overcoming challenges such as inadequate infrastructure, lack of technological support, and insufficient teacher training are crucial for the successful integration of AI in chemistry education. To fully realize the benefits of AI in education, stakeholders must focus on developing comprehensive strategies that not only increase awareness but also provide the necessary tools and support for teachers, ultimately improving the quality of education in Sokoto State and beyond. By addressing these issues, AI can be harnessed as a transformative tool in the teaching and learning of chemistry, enhancing both educational outcomes and teacher effectiveness.

Recommendations

The following recommendations were made based on the findings of the study:

1. provide awareness campaigns and workshops to familiarize teachers with the concepts, benefits, and practical applications of AI in the classroom. Such programs should focus on demonstrating how AI can enhance chemistry teaching, such as through simulations, virtual labs, and personalized learning tools.
2. schools in Sokoto state should invest in the necessary technological infrastructure, such as reliable internet access, AI-enabled platforms, and computer labs, to support the effective use of AI tools. This will enable teachers and students to take full advantage of AI technologies for teaching and learning.
3. AI tools should be adapted to the local educational context, addressing the specific needs and challenges of Sokoto State's secondary schools. This includes developing AI resources that can work effectively in low-resource settings and aligning AI-based educational tools with the local chemistry curriculum.

4. stakeholders should focus on addressing ethical issues and ensuring that privacy concerns are properly managed. Clear guidelines on the ethical use of AI in schools should be developed and communicated to teachers, students, and parents.

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