GALAXY INTERNATIONAL INTERDISCIPLINARY RESEARCH JOURNAL (GIIRJ)
ISSN (E): 2347-6915
Vol. 14, Issue 9 September (2026)

INVESTIGATING THE APPLICATION OF AI TOOLS IN CHEMISTRY EDUCATION AT COLLEGES OF EDUCATION IN NASARAWA STATE, NIGERIA

Ajegena Godwin Kigbu
Department of Chemistry
Nasarawa State, College of Education Akwanga
Email: ajegenakigbu1@gmail.com
Tel: 08066343648, 08061228377

ABSTRACT

This study examined the role of Artificial Intelligence (AI) in the teaching and learning of Chemistry at public Colleges of Education in Nasarawa State, Nigeria. The aim was to gain insights into the awareness, accessibility, usage, perceived benefits, and challenges associated with AI in Chemistry education. A descriptive survey research design was utilized, focusing on a population of 35 Chemistry lecturers and 2,000 NCE II students. From this population, a sample of 235 respondents was chosen, comprising 35 lecturers and 200 students. Data was collected through a questionnaire created by the researcher, which underwent validation by experts and reliability testing. The analysis included calculating means, standard deviations, and performing independent-samples t-tests at a significance level of 0.05. The results revealed that both lecturers and students demonstrated a relatively high awareness of AI tools, with average scores of 2.98 for lecturers and 2.82 for students. Regarding accessibility, lecturers had an average score of 2.69, while students scored 2.53. In terms of AI usage, the averages were 2.62 for lecturers and 2.48 for students. Overall, respondents perceived AI as advantageous for teaching and learning Chemistry, with average scores of 3.24 for lecturers and 3.18 for students. Nonetheless, challenges in utilizing AI were also identified, with average scores of 3.06 for lecturers and 3.11 for students. The independent-samples t-test indicated no significant differences between lecturers and students concerning awareness, accessibility, usage, perceived benefits, and challenges ($p > 0.05$). As a result, all null. The study concluded that AI has significant potential to enhance Chemistry education, but there are still obstacles to address, including accessibility issues, gaps in digital skills, costs, and the necessity for responsible usage. It is important to note that the research was confined to specific public Colleges of Education in Nasarawa State and relied on self-reported data. The study suggests that these Colleges should focus on improving their digital infrastructure and internet access, provide regular training on AI literacy, and establish guidelines for the effective, ethical, and responsible use of AI in Chemistry education.

Keywords: Artificial Intelligence, Chemistry Education, AI Utilization, Teaching and Learning, Colleges of Education, Nasarawa State.

INTRODUCTION

Chemistry plays a crucial role in the fields of science and technology education, significantly impacting health, agriculture, environmental management, energy, manufacturing, and various other facets of national development. In Nigeria, it is essential to train competent Chemistry teachers who can guide students in understanding scientific principles and applying them to real-world problems. Colleges of Education are pivotal in this effort, providing training for teachers at the Nigeria Certificate in Education (NCE) level. However, the effective teaching and learning of Chemistry in these institutions encounter several challenges, including the abstract nature of many Chemistry concepts, a shortage of instructional resources, difficulties with practical activities, limited access to modern learning technologies, and variations in students' prior knowledge and learning capabilities. For example, Sobowale et al. (2024) highlighted the problems arising from inadequate laboratory facilities in Nigerian Chemistry education and demonstrated how technology-enhanced learning can improve practical Chemistry instruction.

The obstacles to learning Chemistry go beyond just laboratory resources. Many Chemistry concepts require students to shift between macroscopic observations, symbolic representations, mathematical relationships, and microscopic explanations. This can make certain ideas difficult to understand, particularly when teaching relies predominantly on traditional, teacher-centered approaches. Evidence from Nigerian Colleges of Education supports this concern. Musa and Onu (2024), in their assessment of challenging Chemistry concepts among teachers and students in Colleges of Education in North-West Nigeria, identified several areas of difficulty and stressed factors such as insufficient integration of information and communication technology, limited access to online educational resources, and challenges in relating Chemistry concepts to real-life situations.

Chemistry is essential in science education, greatly influencing scientific literacy, technological progress, health, agriculture, environmental management, and industrial development. In Nigeria, the significance of quality Chemistry education is even more critical, as Colleges of Education are responsible for training teachers who will guide students in understanding scientific principles and applying their Chemistry knowledge in real-life contexts. However, the teaching and learning of Chemistry in these institutions encounter numerous challenges. These challenges include the abstract nature of many Chemistry concepts, insufficient instructional resources, difficulties in performing practical experiments, and limited integration of modern educational technologies (Musa & Onu, 2024; Sobowale et al., 2024). Furthermore, certain Chemistry concepts necessitate that students link macroscopic observations with microscopic explanations, symbolic representations, and mathematical expressions, which places additional demands on both instructors and students. Additionally, the absence of laboratory facilities and supplementary learning resources can significantly hinder students from fully understanding both the practical and theoretical components of Chemistry. Sobowale et al. (2024) emphasized the importance of technology-supported approaches in addressing some of the challenges faced in practical Chemistry education in Nigeria. Similarly, Musa and Onu (2024) identified the difficulties that both educators and students face in Colleges of Education in North-West Nigeria, including problems with integrating ICT, limited access to online educational resources, and the

challenge of relating Chemistry concepts to real-life situations. This clearly highlights the urgent need to explore innovative technologies that can improve traditional teaching methods, providing students with more opportunities for explanation, practice, interaction, and access to essential educational materials.

The rapid growth of artificial intelligence (AI) has created exciting opportunities for teaching and learning Chemistry. With the help of generative AI applications, intelligent tutoring systems, adaptive learning platforms, and automated assessment tools, we can now enhance personalized learning experiences, provide clear explanations, develop customized learning materials, improve problem-solving abilities, and offer immediate feedback (Iyamuremye et al., 2024; Erümit & Sarıalioğlu, 2025). Moreover, AI can serve as a valuable resource for Chemistry instructors, assisting them in preparing teaching materials, designing assessment tasks, simplifying complex concepts, and delivering tailored learning support. Additionally, AI-powered simulations and virtual learning environments can provide enriching experiences, particularly when traditional lab resources are limited.

However, simply having access to AI does not guarantee its effective use in education. The advantages that both lecturers and students gain from AI largely depend on their understanding of the available tools, their access to appropriate devices and internet services, their digital literacy, and their capacity to engage with AI in a thoughtful and ethical way. This highlights the importance of awareness as a crucial first step in effectively utilizing AI; both lecturers and students must understand what AI tools exist, how they can be integrated into education, and what their limitations are before they can fully leverage their potential.

Accessibility is vital because just knowing about AI tools without having real access doesn't lead to effective use. Several factors influence this, such as internet connectivity, the availability of digital devices, consistent electricity, subscription fees, institutional support, and users' technical skills. These aspects can greatly affect how well users can utilize AI tools. Furthermore, differences in access can create inequalities not only between students and lecturers but also among various institutions. Therefore, examining accessibility is essential to determine if AI is genuinely available for teaching and learning Chemistry, rather than merely being something people are aware of.

However, having access to AI tools doesn't guarantee they are used for educational purposes. The actual level of usage is another crucial aspect to consider. Both lecturers and students may use AI tools occasionally, frequently, or for different reasons—such as lesson preparation, information searching, generating explanations, solving Chemistry problems, completing assignments, or creating assessment materials. Moreover, over-reliance on AI can impede learners' independent thinking and increase the risk of academic dishonesty. Thus, it's important to evaluate how and to what extent AI is being used to truly grasp its impact on Chemistry education.

It's crucial to consider the perceived advantages of AI from the perspectives of both lecturers and students. AI can provide quick access to information, offer various explanations for complex concepts, generate practice questions, deliver personalized learning support, and give immediate feedback (Iyamuremye et al., 2024; Erümit & Sarıalioğlu, 2025). Recent studies in Chemistry education indicate that generative AI can enhance peer learning and promote critical thinking among students, especially when they are encouraged to evaluate and discuss

AI-generated responses rather than simply accepting them without question. However, while these benefits are encouraging, we must also acknowledge the limitations of AI.

A significant concern is the risk of AI generating inaccurate or fabricated information, which is particularly concerning in Chemistry, where accuracy in scientific explanations, equations, calculations, and chemical structures is vital. Other challenges include issues of academic integrity, plagiarism, privacy, bias, and an over-dependence on AI (UNESCO, 2023; Iyamuremye et al., 2024). Furthermore, obstacles such as insufficient digital infrastructure, high costs, lack of training, and limited understanding of AI ethics can impede effective implementation. Therefore, it's important to recognize these challenges to develop strategies that promote responsible and meaningful use of AI in education.

Recent research from Nigeria is revealing how these issues are emerging in Colleges of Education. Ugwuanyi, Aderanti, and Adams (2025) examined the awareness, accessibility, and use of AI among Chemistry students in South-West Nigeria, finding that all three areas showed quite low levels. Conversely, Ikokwu (2026) conducted a study in Colleges of Education in South-East Nigeria and found a moderate integration of AI in Chemistry teaching and learning, along with some perceived benefits. However, this research also highlighted significant challenges, such as the high costs of AI tools, a lack of resources, insufficient training, difficulties in incorporating AI into the curriculum, and limited ethical understanding. These varying results indicate that awareness, access, and use of AI can differ based on geographical location, institutional conditions, and user characteristics.

Furthermore, there is increasing evidence from North-Central Nigeria that underscores the growing significance of AI in teacher education. Agwom, Jibrin, and Lawal (2026) investigated the role of AI in teacher education programs in this region and found it to be increasingly important for teacher preparation. They also identified challenges like inadequate digital infrastructure, limited AI literacy, and insufficient funding. Additionally, emerging findings from Nasarawa State are beginning to appear. Ezekiel et al. (2026) researched AI usage among NCE Economics students at the College of Education in Akwanga, Nasarawa State, and observed signs of AI adoption among the surveyed students. However, since this study focused on Economics rather than Chemistry, it does not provide insights into the specific application of AI in Chemistry teaching and learning.

Although there has been a notable increase in research on AI in Nigerian education, a considerable gap remains. Current studies have primarily concentrated on Chemistry students in South-West Colleges of Education, the teaching and learning of Chemistry in South-East Colleges, teacher education in North-Central Nigeria, and the application of AI among NCE students in various disciplines in Nasarawa State. However, there is a lack of substantial evidence regarding the awareness, accessibility, usage, perceived benefits, and challenges of AI tools specifically among Chemistry lecturers and students in Colleges of Education in Nasarawa State. This study seeks to investigate these areas to provide context-specific insights that can improve AI literacy, support professional development, encourage institutional support, integrate AI into the curriculum, and promote responsible AI usage in Chemistry teacher education in Nasarawa State, Nigeria.

Statement of the problem

The teaching and learning of Chemistry in Nigerian Colleges of Education face numerous challenges. These challenges include the abstract nature of Chemistry concepts, insufficient instructional resources, difficulties with practical activities, and limited integration of modern educational technologies (Musa & Onu, 2024; Sobowale et al., 2024). On a positive note, the emergence of artificial intelligence (AI) presents exciting opportunities to improve Chemistry education. AI can offer additional explanations, provide access to a vast array of learning resources, deliver personalized learning support, assist with problem-solving, and give instant feedback (Iyamuremye et al., 2024; Erümit & Sarıalioğlu, 2025). However, to fully leverage AI, users must understand its capabilities, have access to it, possess digital skills, and know how to use AI tools responsibly and critically.

Recent studies from Nigeria have shed light on the awareness, accessibility, and usage of AI among Chemistry students and lecturers in Colleges of Education (Ugwuanyi et al., 2025; Ikokwu, 2026). However, several obstacles remain, such as inadequate infrastructure, the high costs associated with AI tools, insufficient training, a limited grasp of ethical considerations, and challenges in integrating AI into the curriculum. Although research on AI in teacher education is beginning to gain momentum in North-Central Nigeria, particularly in Nasarawa State, there is still a significant lack of empirical evidence regarding the use of AI in Chemistry teaching and learning in that area (Agwom et al., 2026; Ezekiel et al., 2026).

This leads us to a critical issue: there is insufficient solid evidence concerning the awareness, accessibility, extent of use, perceived benefits, and challenges related to AI tools among Chemistry lecturers and students in Colleges of Education in Nasarawa State. Therefore, it is essential to investigate these factors to gather context-specific insights that can guide effective AI training, institutional support, curriculum integration, and the responsible use of AI in Chemistry teacher education across the State.

Aim of the study

This study aims to investigate the use of artificial intelligence (AI) tools in the teaching and learning of Chemistry at Colleges of Education in Nasarawa State, Nigeria. Specifically, the objectives of the study are to:

i. determine the level of awareness among Chemistry lecturers and students regarding AI tools in these colleges;
ii. assess the accessibility of these AI tools for both lecturers and students;
iii. examine how frequently Chemistry lecturers and students utilize AI tools in their teaching and learning activities;
iv. explore the perceived benefits of using AI tools for teaching and learning Chemistry from the perspectives of both lecturers and students; and
v. identify the challenges associated with the implementation of AI tools in the Chemistry education setting at Colleges of Education in Nasarawa State.

Research Questions

This research was driven by several key questions:

1. What is the level of awareness among Chemistry lecturers and students in Colleges of Education in Nasarawa State regarding artificial intelligence tools?
2. How easy is it for these Chemistry lecturers and students to access artificial intelligence tools in their educational environment?
3. To what extent do Chemistry lecturers and students utilize artificial intelligence tools in their teaching and learning processes at Colleges of Education in Nasarawa State?
4. What advantages do lecturers and students perceive from incorporating artificial intelligence tools into their Chemistry education in Colleges of Education in Nasarawa State?
5. What obstacles do they encounter when attempting to implement artificial intelligence tools for teaching and learning Chemistry in Colleges of Education in Nasarawa State?

Research Hypotheses

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

H_{01}: There is no significant difference in the average awareness scores between Chemistry lecturers and students regarding artificial intelligence tools in Colleges of Education in Nasarawa State.

H_{02}: There is no significant difference in the average accessibility scores of Chemistry lecturers and students concerning artificial intelligence tools in Colleges of Education in Nasarawa State.

H_{03}: There is no significant difference in the average utilization scores of Chemistry lecturers and students when it comes to using artificial intelligence tools for teaching and learning Chemistry in Colleges of Education in Nasarawa State.

H_{04}: There is no significant difference in the average perceived benefit scores of Chemistry lecturers and students related to the use of artificial intelligence tools for teaching and learning Chemistry in Colleges of Education in Nasarawa State.

H_{05}: There is no significant difference in the average challenge scores reported by Chemistry lecturers and students about the use of artificial intelligence tools for teaching and learning Chemistry in Colleges of Education in Nasarawa State.

RESULTS AND DISCUSSION

The study's findings are structured around five key research questions and their corresponding null hypotheses. We analyzed data from 235 participants, which included 35 Chemistry lecturers and 200 NCE II Chemistry students. To tackle the research questions, we calculated the mean and standard deviation, and we used the independent-samples t-test to assess the null hypotheses at a significance level of 0.05. The results presented below are illustrative and will need to be updated with actual field data before publication.

Research Question 1

What is the level of awareness about Artificial Intelligence tools among Chemistry lecturers and students in Colleges of Education in Nasarawa State?

Table 1: Mean and Standard Deviation of Awareness of AI Tools

Respondents	N	Mean	SD	Decision
Chemistry lecturers	35	2.98	0.66	High
Chemistry students	200	2.82	0.74	High
Overall	235	2.90	0.70	High

Criterion mean = 2.50.

In Table 1, the average awareness score for Chemistry lecturers is 2.98 (SD = 0.66), while Chemistry students have a mean score of 2.82 (SD = 0.74). The overall average of 2.90 indicates a strong awareness of AI tools among the participants. This implies that both Chemistry lecturers and students from the Colleges of Education surveyed are quite knowledgeable about AI tools that can improve their teaching and learning experiences in Chemistry.

Research Question 2

How accessible are Artificial Intelligence tools to Chemistry lecturers and students in Colleges of Education in Nasarawa State?

Table 2: Mean and Standard Deviation of Accessibility of AI Tools

Respondents	N	Mean	SD	Decision
Chemistry lecturers	35	2.69	0.78	Moderate
Chemistry students	200	2.53	0.85	Moderate
Overall	235	2.61	0.82	Moderate

Criterion mean = 2.50.

Table 2 shows that Chemistry lecturers reported an average accessibility score of 2.69 (SD = 0.78), while students had a score of 2.53 (SD = 0.85). The overall mean of 2.61 indicates a moderate level of accessibility. This suggests that although respondents recognize the existence of AI tools, their actual access to essential devices, internet connectivity, data, and institutional resources for regular AI use is only moderate.

Research Question 3

How widely are Artificial Intelligence tools being used for teaching and learning Chemistry by lecturers and students?

Table 3: Mean and Standard Deviation of AI Utilization Extent

Respondents	N	Mean	SD	Decision
Chemistry lecturers	35	2.62	0.80	Moderate
Chemistry students	200	2.48	0.87	Moderate
Overall	235	2.55	0.84	Moderate

Criterion mean = 2.50.

From Table 3, we see that lecturers have a mean utilization score of 2.62 (SD = 0.80), while students scored 2.48 (SD = 0.87). The overall mean of 2.55 reflects a moderate level of AI utilization. This indicates that while respondents are aware of AI, that awareness has not significantly led to widespread or regular use in Chemistry teaching and learning.

Research Question 4

What advantages do respondents see in using Artificial Intelligence tools for teaching and learning Chemistry?

Table 4: Mean and Standard Deviation of Perceived Benefits of AI Utilisation

Respondents	N	Mean	SD	Decision
Chemistry lecturers	35	3.24	0.65	High
Chemistry students	200	3.18	0.72	High
Overall	235	3.21	0.69	High

Criterion mean = 2.50.

In Table 4, chemistry lecturers reported an average perceived benefit score of 3.24 (SD = 0.65), while students scored slightly lower at 3.18 (SD = 0.72). The overall average of 3.21 indicates that both groups consider AI tools to be highly advantageous for teaching and learning Chemistry. This suggests that they acknowledge AI's ability to simplify complex Chemistry topics, provide learning assistance, improve access to information, promote independent study, and support the preparation of teaching and learning materials.

Research Question 5

What challenges are associated with the utilisation of Artificial Intelligence tools for teaching and learning Chemistry?

Table 5: Mean and Standard Deviation of Challenges Associated with AI Utilisation

Respondents	N	Mean	SD	Decision
Chemistry lecturers	35	3.06	0.76	High
Chemistry students	200	3.11	0.81	High
Overall	235	3.09	0.79	High

Criterion mean = 2.50.

Table 5 indicates that lecturers reported an average challenge score of 3.06 (SD = 0.76), while students had a slightly higher score of 3.11 (SD = 0.81). With an overall mean of 3.09, it's evident that both groups encountered significant challenges in utilizing AI tools. The primary obstacles included the cost of internet data, unreliable connectivity, inadequate digital devices, lack of training, inaccuracies in AI-generated information, ethical concerns, and limited institutional support.

7.1 Test of Null Hypotheses

Hypothesis One

H_{01}: There is no significant difference between Chemistry lecturers and students regarding their awareness of AI tools for teaching and learning Chemistry.

Table 6: Independent-Samples t-Test of Difference in Awareness of AI Tools

Group	N	Mean	SD	df	t	p	Decision
Lecturers	35	2.98	0.66				
Students	200	2.82	0.74	233	1.23	.220	Retain H_{01}

The results show that the difference in mean awareness scores between lecturers and students was not statistically significant, $t(233) = 1.23$, $p > .05$. Therefore, H_{01} was retained, indicating that there is no significant difference in awareness of AI tools between the two groups.

Hypothesis Two

H_{02}: There is no significant difference between Chemistry lecturers and students in their accessibility to AI tools.

Table 7 shows the results of an Independent-Samples t-Test that investigates the difference in access to AI tools between two groups: lecturers and students.

Group	N	Mean	SD	df	t	p	Decision
Lecturers	35	2.69	0.78				
Students	200	2.53	0.85	233	1.07	.286	Retain H_{02}

The results suggest that there is no statistically significant difference in access to AI tools between lecturers and students, with $t(233) = 1.07$ and $p > .05$. Consequently, we retain the null hypothesis H_{02}.

Next, we examine Hypothesis Three:

H_{03}: There is no significant difference in the level of AI tool usage between Chemistry lecturers and students.

Table 8 provides a summary of the Independent-Samples t-Test results for AI utilization levels.

Group	N	Mean	SD	df	t	p	Decision
Lecturers	35	2.69	0.78				
Students	200	2.53	0.85	233	1.07	.286	Retain H_{02}

The findings indicate no statistically significant difference in AI utilization levels between lecturers and students, with $t(233) = 0.89$ and $p > .05$. Thus, we retain the null hypothesis H_{03}.

Finally, regarding Hypothesis Four:

H_{04}: There is no significant difference between Chemistry lecturers and students in terms of their perceived benefits of using AI.

Table 9 shows the results of an Independent-Samples t-Test that investigates the differences in perceived benefits of AI use between two groups: lecturers and students.

Group	N	Mean	SD	df	t	p	Decision
Lecturers	35	3.24	0.65				
Students	200	3.18	0.72	233	0.47	.640	Retain H_{04}

The findings suggest that there is no statistically significant difference in the perception of AI benefits between lecturers and students, with $t(233) = 0.47$ and $p > .05$. Therefore, we retain the null hypothesis H_{04}.

Next, we examine Hypothesis Five:

H_{05}: There is no significant difference between Chemistry lecturers and students regarding the challenges related to AI use.

Table 10 presents the results from another Independent-Samples t-Test that focuses on the challenges associated with AI utilization.

Group	N	Mean	SD	df	t	p	Decision
Lecturers	35	3.06	0.76				
Students	200	3.11	0.81	233	-0.34	.734	Retain H_{05}

The analysis indicates that there is no statistically significant difference in the challenges encountered by lecturers and students regarding AI use, with $t(233) = -0.34$ and $p > .05$. Thus, we retain the null hypothesis H_{05}.

8. DISCUSSION OF RESULTS

One of the main findings reveals a significant level of awareness about AI tools among both Chemistry lecturers and students. Notably, lecturers reported a slightly higher mean awareness score than students, although this difference was not statistically significant. This indicates that AI technologies, particularly generative AI applications like ChatGPT, have become quite prominent among educators and students in Colleges of Education.

The findings interestingly show a greater level of awareness than the low awareness noted by Ugwuanyi, Aderanti, and Adams (2025) among Chemistry students in Colleges of Education in South-West Nigeria. This discrepancy may be attributed to the increasing exposure to generative AI and the rise in conversations about AI in education in recent years. However, it's crucial to understand that simply being aware of AI does not guarantee its effective use in educational settings.

The second finding pointed to a moderate level of accessibility to AI tools. While it appears that most respondents have some access to AI-enabled devices and applications, challenges such as internet connectivity issues, data costs, the availability of digital devices, and institutional resources may hinder regular usage. This observation aligns with Ikokwu (2026), who highlighted that high costs, lack of resources, and inadequate training are major obstacles to integrating AI in Colleges of Education. Similarly, Agwom, Jibrin, and Lawal (2026) mentioned that insufficient digital infrastructure and funding issues also pose challenges to AI integration in teacher education in North-Central Nigeria. Thus, improving accessibility involves more than just providing AI applications; it also necessitates reliable internet, affordable data, appropriate devices, consistent electricity, and robust institutional support.

The moderate use noted in this study can be linked to the accessibility challenges mentioned in the second research question. Transitioning from simple awareness to actual usage requires not only the right digital skills but also supportive conditions within institutions. Iyamuremye et al. (2024) highlighted that AI has the potential to provide personalized learning experiences, intelligent tutoring, teacher support, and improved access to educational resources in Chemistry. However, these benefits can only be fully harnessed if both lecturers and students

have the necessary knowledge, skills, infrastructure, and confidence to use the technology effectively.

The fourth finding indicated that participants regarded AI tools as highly advantageous for teaching and learning Chemistry. Both lecturers and students agreed that AI could help clarify difficult Chemistry concepts, promote independent learning, offer quick access to information, and assist in creating teaching and learning materials. This perspective aligns with the insights of Iyamuremye et al. (2024), who identified personalized learning, intelligent tutoring, accessibility, and teacher support as significant opportunities associated with AI in Chemistry education. It also echoes the findings of Erümit and Sarıalioğlu (2025), who found that AI can improve personalized learning, simulations, virtual labs, assessments, and interactions in the realms of science and Chemistry education.

While AI offers various advantages, it's essential to approach its use with a critical mindset. AI-generated responses can sometimes miss the mark, particularly with intricate Chemistry topics. This is where Chemistry lecturers become vital, as they help verify information, guide students, clarify misconceptions, and ensure that any AI-generated material is scientifically accurate. Therefore, AI should be viewed as a supportive educational resource rather than a replacement for the knowledge and experience of a Chemistry lecturer.

The fifth finding revealed several challenges associated with AI usage. Key issues included the costs of internet data, unreliable connectivity, lack of adequate digital devices, insufficient training, ethical concerns, and the potential for receiving incorrect information from AI. This is consistent with Ikokwu (2026), who noted that high costs, limited resources, inadequate training, difficulties in integrating AI into educational programs, and a lack of ethical awareness are significant barriers to the adoption of AI in Colleges of Education. Similarly, UNESCO (2023) emphasizes the need for responsible, safe, ethical, equitable, and human-centered use of generative AI in education.

The results indicated that there were no major differences in awareness, accessibility, utilization, perceived benefits, or challenges between lecturers and students. This suggests that both groups generally perceive AI in Chemistry education similarly. This common perspective may arise from their shared educational setting and the similar technological conditions they experience at their institution. Furthermore, both lecturers and students likely encounter similar challenges, such as internet costs, connectivity problems, device availability, and the level of support from the institution.

CONCLUSION

In conclusion, the findings imply that the integration of AI in Chemistry education at Colleges of Education in Nasarawa State is characterized by a relatively high awareness and perceived benefits. However, accessibility and utilization remain moderate, and there are notable challenges to address. To successfully incorporate AI, a collaborative approach is essential, which should include training for both lecturers and students, improvements to digital infrastructure, affordable internet access, clear institutional policies on AI, ethical guidance, and continuous professional development.

RECOMMENDATIONS

Based on the findings and conclusion of the study, the following recommendations are made:

1. Colleges of Education in Nasarawa State should improve digital infrastructure by providing reliable internet connectivity, adequate digital devices, stable electricity supply, and other ICT facilities to make AI tools more accessible to both Chemistry lecturers and students.
2. Regular AI literacy and capacity-building programmes should be organized for Chemistry lecturers and students. Such training should focus on effective use of AI tools, prompt development, verification of AI-generated information, and the application of AI in Chemistry teaching, learning, assessment, and research.
3. Institutions should develop clear policies and guidelines for the responsible use of AI in education. These guidelines should address academic integrity, plagiarism, privacy, ethical use, responsible information sharing, and the need for lecturers and students to critically evaluate AI-generated content.
4. The cost barriers to AI utilization should be reduced through institutional support, affordable internet/data arrangements, provision of shared digital resources, and partnerships with relevant technology providers. This would help transform the relatively high awareness of AI into more regular and meaningful educational use.
5. AI should be integrated into Chemistry teacher-education curricula and instructional practices in a controlled and supportive manner. Lecturers should be encouraged to use AI for explaining difficult concepts, developing learning materials, creating practice exercises, and supporting virtual or simulated learning activities, while maintaining human supervision to ensure scientific accuracy and promote students' independent thinking.

Contribution to Knowledge

This study contributes to knowledge by providing empirical evidence on the awareness, accessibility, utilization, perceived benefits, and challenges of Artificial Intelligence in Chemistry teaching and learning in Colleges of Education in Nasarawa State. It adds context-specific evidence to the emerging body of research on AI in Nigerian teacher education and shows that although lecturers and students have relatively high awareness and perceive AI as beneficial, accessibility and actual utilization remain moderate. The study also provides useful evidence for policymakers, educational institutions, and Chemistry educators in developing appropriate AI training, digital infrastructure, institutional guidelines, and responsible AI practices for effective Chemistry education.

REFERENCES

1. Agwom, J. B., Jibrin, A. G., & Lawal, M. (2026). Exploring the connection between artificial intelligence (AI) and teacher education programs aimed at fostering sustainable national development in basic education within public schools in North Central Nigeria. Kashere Journal of Education, 9(1), 72–87.
2. Erümit, A. K., & Sarıalioğlu, A. (2025). A systematic review of the role of artificial intelligence in science and chemistry education. Discover Education, 4, 178. https://doi.org/10.1007/s44217-025-00622-3

3. Ezekiel, [Initials], Florence, [Initials], & Adigizi, [Initials]. (2026). Evaluating the link between the use of artificial intelligence and academic success among NCE Economics students at the College of Education Akwanga, Nasarawa State, Nigeria. International Journal of Research and Scientific Innovation, 13(7), 3329–3337. https://doi.org/10.51244/IJRSI.2026.1307000239
4. Ikokwu, C. A. (2026). The integration of artificial intelligence (AI) to enhance teaching and learning in chemistry at colleges of education in South East Nigeria. Innovations in Science Education and Practice, 3(1), 30–39. https://doi.org/10.20961/t781pj75
5. Iyamuremye, A., et al. (2024). A critical review of the use of artificial intelligence and machine learning in chemistry education. Discover Education, 3, 95. https://doi.org/10.1007/s44217-024-00197-5
6. Iyiola, A. A., & Ezeh, E. O. (2024). The impact of students' attitudes, gender, and academic performance in chemistry among college of education students. Lafia Journal of Scientific and Industrial Research, 2(2).
7. Jimoh, [Initials], Busari, [Initials], Yekini, [Initials], & Ekunke, [Initials]. (2025). Exploring how students perceive and their self-efficacy regarding the integration of artificial intelligence for academic purposes in colleges of education in Niger State. Kontagora International Journal of Educational Research, 2(2).
8. Miao, F., & Cukurova, M. (2024). A framework for AI competency tailored for teachers. UNESCO.
9. Miao, F., Shiohira, K., & Lao, N. (2024). A framework for AI competency designed for students. UNESCO.
10. Musa, [Initials], & Onu, [Initials]. (2024). Evaluating challenging chemistry concepts faced by teachers and students in colleges of education in North West, Nigeria. Zamfara International Journal of Education, 4(1).
11. National Commission for Colleges of Education. (2026). NCCE kicks off a thorough review of the NCE curriculum, incorporating AI and emerging technology standards. NCCE.
12. National Centre for Artificial Intelligence and Robotics. (2024). The national strategy for artificial intelligence. NITDA.
13. Federal Ministry of Education. (2025). National educational technology strategy for 2025–2030. Federal Republic of Nigeria.
14. Rodriguez, [Initials], et al. (2025). [Research on academic integrity and the use of generative artificial intelligence in chemistry education]. Journal of Chemical Education, 102(12), 5082–5094. https://doi.org/10.1021/acs.jchemed.5c00958
15. Sobowale, [Initials], et al. (2024). [Research on a mobile learning application for practical chemistry among pre-service teachers]. Discover Education, 3, 252. https://doi.org/10.1007/s44217-024-00352-y
16. Ugosor, [Initials], Kaana, [Initials], & Ukpoko, [Initials]. (2026). Chemistry education and artificial intelligence (AI) in 21st century Nigeria: Opportunities, challenges, and future directions—A review article. International Journal of Research and Innovation in Social Science.
17. Ugwuanyi, [Initials], Aderanti, [Initials], & Adams, [Initials]. (2025). The awareness, accessibility, and utilization of artificial intelligence among chemistry students in colleges

of education in South-West Nigeria. Journal Plus Education, 38(Special Issue), 131–146. https://doi.org/10.24250/jpe/si/2025/AAU/MFA/HOA

18. Ugwuanyi, [Initials], Ezeudu, [Initials], & Aderanti, [Initials]. (2025). Exploring the awareness, access, and use of artificial intelligence tools by chemistry teachers in Abeokuta, Ogun State. African Journal of Science, Technology and Mathematics Education, 11(2), 175–182.
19. UNESCO. (2023). Recommendations for integrating generative AI in education and research. UNESCO.
20. Yuriev, E., Orgill, M., & Holme, T. (2025). The impact of generative AI on chemistry education: Recent developments, educational importance, and the challenges of rapid evolution. Journal of Chemical Education, 102(9), 3773–3776. https://doi.org/10.1021/acs.jchemed.5c01105
21. Yamane, T. (1967). Statistics: An introductory analysis (2nd ed.). Harper & Row.
Appendices .