




## ACCESSIBILITY AND USABILITY OF GENERATIVE AI FOR TEACHING AMONG SECONDARY SCHOOL CHEMISTRY TEACHERS IN ILORIN METROPOLIS, KWARA STATE

Abdulmuhsin IBRAHIM<sup>1</sup>, Adedolapo Abdulahi AHMED<sup>2</sup>, Waheed Tunde OYEYEMI<sup>3</sup>

<sup>1\*2\*3</sup>Department of Science Education, Faculty of Education, Al-Hikmah University, Ilorin, Nigeria.

Corresponding Email: [Abdulmuhsinibrahim72@gmail.com](mailto:Abdulmuhsinibrahim72@gmail.com)

<p><b>ARTICLE HISTORY</b> Received [20 October 2024] Revised [30 November 2024] Accepted [11 December 2024]</p>	<p><b>ABSTRACT</b> This study examines how easily secondary school chemistry teachers in Ilorin Metropolis, Kwara State, can access and use generative AI tools. Assessing instructors' knowledge of generative artificial intelligence (AI), the accessibility of these resources, and their usefulness in chemistry instruction was its primary goal. Data were gathered from 333 chemistry teachers in the city's different local administrations using a descriptive survey design. The results showed significant awareness gaps, with many teachers not knowing about the benefits and pedagogical potential of generative artificial intelligence. Furthermore, it was discovered that these programs had restricted accessibility; the only one with moderate availability was ChatGPT. The survey also found that using the majority of AI tools in classroom settings can be difficult. The study suggests creating focused professional development programs to increase teachers' comprehension of generative artificial intelligence in light of these findings. It also recommends expanding access to these tools by giving schools the resources and infrastructure they require. Furthermore, more approachable, teacher-focused AI systems that are tailored to the unique requirements of chemistry education must be developed. These steps are intended to help educators better incorporate AI into their lesson plans and improve students' understanding of difficult chemistry concepts.</p>
<p><b>KEYWORDS</b> Generative AI, Chemistry Education, Accessibility, Usability, Professional Development</p>	
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### INTRODUCTION

By providing creative ways to improve teaching and learning, artificial intelligence (AI) is quickly changing the educational landscape. AI systems can analyse data, learn from it, and make defensible conclusions because they are made to mimic human intelligence (Jarrahi et al., 2023). From straightforward algorithms for sorting and searching to complex models that can comprehend plain language, identify photographs, and even have interactive conversations, this technology has advanced dramatically over time. According to Sajja et al. (2024), artificial intelligence (AI) in education refers to the use of cutting-edge technologies to assist educational procedures including intelligent tutoring systems, automated grading, and personalised learning. AI evaluates student data using sophisticated algorithms to customise learning experiences, increasing student engagement and improving learning results (Cai, 2024). Additionally, educators can improve their teaching methods and make well-informed decisions because of AI's capacity to process and interpret enormous volumes of data (Oluyemisi, 2023). As a result, incorporating AI into education is not only changing the way that knowledge is taught, but it is also getting students ready for a time when technology will be used in many facets of daily life. The creation and application of systems that mimic human intelligence to carry out a wide range of tasks is known as artificial intelligence (AI) (Ebuka et al., 2023). Through the use of complex models and algorithms, AI examines data, gains knowledge from it, and makes defensible choices. Its evolution has gone from basic sorting and searching algorithms



to more powerful systems capable of interpreting natural language, recognizing photos, and even engaging in discussions with users. This revolution has been fuelled by increases in computer power, the availability of huge datasets, and the development of machine learning, which is vital for training AI systems (Ezugwu et al., 2023).

AI is present in many technologies that we use daily, including virtual assistants, facial recognition software, and recommendation algorithms that make suggestions for films, music, and products. The ability of AI to carry out tasks that are often associated with human intelligence is its fundamental concept. Narrow or classical AI, which focuses on certain tasks like language translation or object detection in photos, is the most prevalent type of AI. But as AI's capabilities have grown beyond these specific functions, Generative Artificial Intelligence (Generative AI) has emerged. By enabling machines to produce creative material instead of merely processing or analysing preexisting data, generative AI provides a substantial advancement above standard AI (Ngbarabara & Odibo, 2024). Through the analysis and learning of vast datasets, this technology may provide original outputs, such as text, photos, audio, and videos. By creating unique outputs based on patterns learnt, generative AI seeks to mimic human creative processes (Onyejelem & Aondover, 2024). In contrast to simple data processors, generative AI systems work more like artists, creating new expressions based on training examples. This is a significant turning point in the development of AI, as it moves from analysis and problem-solving to creative generation. Machine learning advances, especially the creation of models like Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs), have been mainly responsible for the emergence of generative artificial intelligence (Akande et al., 2024). Two neural networks—a generator and a discriminator—compete with one another in the special way that GANs work. Samples are generated by the generator and evaluated by the discriminator, which separates generated and actual data. The generator is incentivised by this competitive dynamic to generate content that more closely mimics real data.

On the other hand, VAEs create new samples by distilling data into core representations (Akande et al., 2024). These models have produced excellent photos, films, and other kinds of information that are frequently indistinguishable from real data. The quality and applicability of the content produced are greatly impacted by the structure of these models, which are frequently built on deep neural networks. In domains like natural language processing (NLP), which is essential for AI systems to produce text that is coherent and contextually relevant, architectures like transformers and recurrent neural networks (RNNs) have shown impressive results (Shihab et al., 2023). The field has been transformed by transformers in particular, which enable models such as GPT (Generative Pre-trained Transformer) to comprehend and anticipate word sequences, producing text that flows naturally. These models can learn linguistic patterns by using large training datasets, which allows them to provide surprisingly meaningful and accurate responses to prompts (Adetayo, 2023).

The ability of Generative AI to learn from large amounts of unlabelled data by predicting missing parts of the information they analyse (Salau et al., 2024) is one of its noteworthy features. This approach allows models to deeply understand patterns and contexts, which is crucial for producing coherent and logical responses. It has proven particularly useful for text generation, allowing AI to maintain a natural tone and produce content across a variety of topics. This ability allows models such as GPT to predict the next word in a sentence, producing text that is fluid and contextually relevant. Generative AI applications are found in a wide range of industries, such as education, healthcare, customer service, and content creation (Anantrasirichai & Bull, 2022). For



example, in content creation, Generative AI can create articles, poetry, images, music, and videos. It can assist authors by drafting or summarizing content and can even generate images based on textual descriptions, which is particularly advantageous for design and marketing purposes. In customer service, Generative AI powers chatbots and virtual assistants that respond to inquiries with a level of accuracy that mimics human interaction. Such applications reduce the necessity for human intervention in routine support tasks, thereby freeing up valuable time and resources (Khennouche et al., 2024). Generative AI also shows promise in the healthcare sector, contributing to tasks such as drug discovery and diagnostic imaging (Prabhod, 2023). By generating molecular structures, it aids in the swift identification of potential new drugs, thereby advancing medical research. Additionally, Generative AI can create synthetic medical images that are instrumental in training healthcare professionals and enhancing diagnostic tools (Abbasi et al., 2024).

In the educational sphere, it personalizes learning by creating customized quizzes and study materials that adapt to individual student needs, making the learning experience more engaging (Binhammad et al., 2024). While the advantages of Generative AI are considerable, it also raises significant ethical concerns. One major issue is the potential for misuse, as Generative AI can produce deepfakes and misleading content that may misinform the public. This concern underscores the necessity for regulations and ethical guidelines to ensure the responsible use of Generative AI in ways that protect individuals and communities (Ijiga et al., 2023). Privacy is another critical issue, as Generative AI often relies on large datasets that may include sensitive information. This reliance on data poses risks, particularly if models inadvertently disclose details from their training data, potentially compromising individual privacy. Intellectual property is yet another area impacted by Generative AI, as AI-generated content can sometimes closely resemble works created by humans (Nutsugah & Senanu, 2024). This overlap raises important questions about authorship, ownership, and copyright. Many artists, writers, and other content creators express concern that their work is used to train AI without their consent. Balancing the drive for innovation with respect for intellectual property rights poses a challenge for developers and policymakers alike. Furthermore, Generative AI models can reflect biases present in their training data, leading to biased or unfair content (Olubiyi et al., 2024). This challenge necessitates careful data curation and ongoing efforts to mitigate bias in AI outputs. Looking ahead, the potential of Generative AI remains vast and promising. Future advancements may enable AI systems to become even more versatile, capable of integrating multiple types of media—text, audio, images, and video—to create immersive and interactive experiences for users (Khaldi, 2024). For example, educational tools could blend these elements to foster richer learning environments.

Additionally, Generative AI is expected to further enhance human creativity, offering tools that support artists, scientists, and innovators across various fields (Onyejelem & Aondover, 2024). By empowering individuals to experiment with ideas and develop innovative solutions, Generative AI holds significant potential for collaborative and interdisciplinary advancements (Aderibigbe et al., 2023). Research aimed at making Generative AI more transparent and comprehensible is also underway. As the interaction between users and these systems increases, the need for clarity in understanding how and why AI produces specific outputs becomes crucial (Akwang & Ebiwolate, 2024). Explainable AI—a field dedicated to elucidating AI processes—plays a vital role in building trust and promoting the responsible use of AI technologies. Generative AI tools, like ChatGPT and similar systems, are being integrated more



frequently in educational settings, offering innovative ways to support teaching and learning (Gaspard-Richards, 2023). Research by Yan et al. (2024) highlights that generative AI can personalize feedback for students, helping teachers respond to individual learning needs effectively. This study found that AI-enabled feedback could adapt based on student responses, allowing educators to pinpoint and support specific areas for improvement, particularly in language arts and social studies. This efficiency enables teachers to focus on deeper, interactive teaching activities while the AI assists with routine feedback tasks, improving classroom productivity. Additionally, generative AI's ability to assist in creating educational content has proven valuable. Mabrouk (2024) examined how tools like ChatGPT can generate quizzes, test questions, and multimedia resources, which teachers can use to better tailor instructional materials to different proficiency levels. This approach resulted in higher student engagement and motivation, as learning materials became more relevant to their individual needs.

AI's adaptability also allows teachers to modify or refresh content quickly, providing more flexibility than traditional methods. However, some studies raise concerns regarding the impact of heavy reliance on generative AI in education, particularly related to academic integrity and skill development. Mohebbi (2025) discusses how students might rely too much on AI for assignments, potentially hindering their growth in essential skills like critical thinking and analysis. There is a risk that students may bypass deeper learning and miss out on critical practice if they depend on AI-generated content for writing or assignments. To address this, Mohebbi recommends using AI as a supplementary aid rather than a primary source, allowing students to engage actively with the material while benefiting from the technology's support. Adapting generative AI to existing educational standards and curricula presents another challenge for educators. Lanham and Smith (2025) emphasize the importance of clear guidelines for using AI in classrooms. They suggest that educational institutions provide structured policies to ensure that AI is used to support learning without detracting from essential skills and objectives. By establishing guidelines on how both students and teachers should interact with AI, schools can help prevent its misuse and ensure it serves as a valuable resource rather than a distraction. In STEM education, especially in math and science, generative AI has been shown to aid in solving problems and explaining complex concepts. Chen and Li's (2022) study highlights how AI can provide example problems, break down solutions step-by-step, and clarify challenging topics interactively. This hands-on support benefits students who need additional help with difficult concepts, offering immediate feedback and explanations. However, the researchers caution that relying too much on AI could weaken students' ability to think independently, reinforcing the need for a balanced implementation that encourages students to develop their problem-solving skills. These findings suggest that with well-planned application, generative AI has the potential to enhance teaching practices meaningfully, provided its use is structured to maximize its advantages while addressing possible drawbacks. Recent research focusing on the awareness and implementation of generative AI in Nigeria's secondary education has revealed both the advantages and challenges associated with these technologies. A significant study conducted by the World Bank in Edo State introduced a program that incorporated generative AI into secondary school classrooms, particularly for English language teaching.

This initiative highlighted that tools like Microsoft Copilot can effectively improve students' grammar and writing skills. Teachers played a crucial role in these sessions, helping students utilize AI-generated prompts and refine their written work. This approach indicated that students could engage in self-directed learning with the support



of AI. The findings also emphasized the importance of professional development for teachers to optimize the integration of AI in educational settings (World Bank, 2024). Similarly, Adelana and Akinyemi (2021) examined the awareness of AI among secondary school teachers in Nigeria. The research, which surveyed educators from various schools, found that while many teachers recognized the potential of AI technologies, their specific understanding of generative AI was quite limited. Educators expressed optimism regarding AI's ability to enhance instructional methods and provide personalized feedback, especially in subjects like mathematics and language arts, which require significant practice. However, the study identified a considerable barrier in the form of insufficient digital resources and training. This highlights the need for institutional support to close the knowledge gap and facilitate effective AI integration. Research by Cooper (2023) further explored the influence of generative AI on science education. Their study found that using AI to create complex problem sets and deliver detailed explanations in subjects such as physics and chemistry significantly increased student engagement and comprehension. Nonetheless, the researchers raised concerns about the potential for students to become overly dependent on AI tools, which could impede their development of independent problem-solving skills. They advocated for the use of generative AI as a supplementary resource, recommending that teachers provide structured guidance to ensure that students remain actively involved in their learning of scientific concepts.

Together, these studies highlight the dynamic role of generative AI in enhancing secondary education in Nigeria. They also underscore the necessity for targeted teacher training and the establishment of institutional frameworks to fully leverage the capabilities of AI. As generative AI tools become more widely available, the development of organized strategies for their integration could significantly improve teaching practices and learning outcomes for students.

### **Purpose of the Study**

The main purpose of this study was to investigate the Accessibility and Usability of Generative AI for teaching among secondary school Chemistry teachers in Ilorin Metropolis, Kwara State. The study was specifically:

1. determined the awareness level of secondary school Chemistry teachers on Generative AI for teaching in Ilorin Metropolis, Kwara State;
2. find out the accessibility rate of secondary school Chemistry teachers on Generative AI in Ilorin Metropolis, Kwara State;
3. examined the usability level of Generative AI for teaching among secondary school teachers in Ilorin Metropolis, Kwara State;

### **Research Questions**

The following research questions were answered in this study:

1. What is the awareness level of secondary school Chemistry teachers on Generative AI for teaching in Ilorin Metropolis, Kwara State?
2. What is the accessibility rate of secondary school Chemistry teachers on Generative AI in Ilorin Metropolis, Kwara State?
3. What is the usability level of Generative AI for teaching among secondary school Chemistry teachers in Ilorin Metropolis, Kwara State?

## **RESEARCH METHODOLOGY**

This study employed a descriptive research design of the survey type. The study collected data that was used to answer the research questions. The responses from respondents to the questionnaire on awareness, accessibility, and usability of Generate

AI were used to determine awareness, accessibility, and usability the Generative AI for teaching Chemistry in Ilorin Metropolis, Kwara State. The population of this study was 4516 senior secondary school teachers in Ilorin Metropolis, Kwara State while the target population was 333 secondary school Chemistry teachers in Ilorin Metropolis. In this study, a multistage sampling method was used. First, twenty secondary schools were selected using a purposive sampling, with four schools selected from each of the five local governments within Ilorin Metropolis. Then, secondary school teachers from grades 7-15 were selected using a stratified sampling. Random sampling was used to select 32 Chemistry teachers from Asa, 61 Chemistry teachers from Ilorin East, 87 Chemistry teachers from Ilorin South, 125 Chemistry teachers from Ilorin West and 28 Chemistry teachers from Moro Local Government, resulting in 333 respondents. The higher number of Chemistry teachers from Ilorin West is due to it being the most populous local government with the most secondary school teachers in Ilorin Metropolis. The instrument for this study was a researcher-designed questionnaire titled Awareness, accessibility, and Usability of Generative AI among secondary school teachers in Ilorin Metropolis, Kwara State (AAUGAITSSCT). The questionnaire comprised two sections. Section A deals with the demographic information about the respondents, such as their school name, gender, and area of specialization. Section B contains three parts: B1 contains the awareness level, B2 contains the accessibility rate, and B3 contains the usability of Generative AI for teaching Chemistry in secondary schools. The instrument on Awareness level, Accessibility rate and Usability level of Generative AI among secondary school Chemistry Teachers in Ilorin Metropolis, Kwara State (AAUGAITSSCT) was validated by three lecturers from the Department of Science Education, Al-Hikmah University, Ilorin, Nigeria. The instrument was subjected to a pilot study of 40 secondary school teachers outside the locale of the study (Ifelodun Local Government Area) of Kwara State. The reliability scores of 0.72, 0.78 and 0.84 of each of the sections of the instrument were ascertained using the Cronbach Alfa Coefficient at 0.05 level of significance. The collected data was analyzed using descriptive statistics. All research questions were answered using descriptive statistics of mean, frequency counts and standard deviation. The Statistical Product and Service Solution (SPSS) was used to analyse the data at 0.05 level of significance.

## RESULT AND DISCUSSION

**Table 1.** Awareness level of secondary school Chemistry teachers on Generative AI for teaching in Ilorin Metropolis, Kwara State.

SN	ITEMS	HA	MA	SA	NA	MEAN	ST.D
1	I am aware of the concept of Generative AI	21	81	89	142	1.3664	0.95991
2	I am aware of the existence of Generative AI specifically designed for secondary school teaching	22	86	84	141	1.9670	0.97350
3	I am aware about the benefits of using Generative AI in enhancing student learning outcomes	16	97	73	147	1.9459	0.96165
4	I am aware of the different types of Generative AI available for various subjects in secondary education	3	37	115	178	1.5946	0.72034
5	I am aware of the integration of Generative AI into the secondary school curriculum	0	18	86	229	1.3664	0.58419
6	I am aware of the potential challenges and solutions associated with using Generative AI in teaching	0	12	88	233	1.3363	0.54422



Table 1 indicates a generally low level of awareness among secondary school chemistry teachers in Ilorin Metropolis, Kwara State, about the use of Generative AI in teaching. The majority of teachers were either "Not Aware" or "Somewhat Aware" of Generative AI, with 29.0% of respondents indicating a limited understanding of the concept. The majority also had limited familiarity with Generative AI specifically tailored for secondary school instruction, with 28.8% choosing "Not Aware" and 4.5% as "Highly Aware." The majority also had limited awareness of Generative AI's potential to enhance student learning outcomes, with 30.0% marking "Not Aware" and a mean score of 1.9459. The data also showed minimal awareness of the various types of Generative AI available for secondary education subjects, with 36.3% of teachers selecting "Not Aware" and a mean score of 1.5946. The integration of Generative AI into the secondary school curriculum was also low, with 46.7% of teachers being "Not Aware," and none indicating a high level of awareness. Furthermore, knowledge about challenges and solutions related to using Generative AI in education was low, with 47.6% indicating "Not Aware." The study underscores the need for focused professional development to enhance teachers' understanding of Generative AI's role and potential in education.

**Table 2.** Accessibility rate of secondary school Chemistry teachers on Generative AI in Ilorin Metropolis, Kwara State.

SN	ITEMS	HA	MA	SA	NA	MEAN	ST.D
1	ChatGPT (OpenAI)	71	130	56	76	2.5886	1.06227
2	Chemistry Assistant (Wolfram Alpha)	0	11	43	279	1.1952	0.47311
3	PhET Interactive Simulations	0	42	53	238	1.4114	0.70420
4	Labster	0	9	47	277	1.1952	0.46020
5	MEL Chemistry VR	0	12	37	284	1.1832	0.47156
6	EduBot (Chatbot for Chemistry Tutoring)	0	0	57	276	1.1712	0.37723
7	DeepChem	0	15	50	268	1.2402	0.52291
8	Explain Everything	0	0	50	283	1.1502	0.35776
9	Flinn Scientific's Chemventory	0	18	53	262	1.2673	0.55214
10	Desmos Chemistry Tools	0	0	36	297	1.1081	0.31098

Table 2 shows that secondary school chemistry instructors in Ilorin Metropolis, Kwara State, have restricted access to instructional Generative AI technologies. ChatGPT by OpenAI is the most accessible tool, with 14.5% of instructors ranking it "Highly Accessible" and 26.5% as "Moderately Accessible," resulting in a mean score of 2.5886. The standard deviation of 1.06227 implies some accessibility variance, although this tool looks more accessible than others. Chemical Assistant by Wolfram Alpha, PhET Interactive Simulations, Labster, MEL Chemistry VR, EduBot, DeepChem, Explain Everything, Flinn Scientific's Chemventory, and Desmos Chemistry Tools are less accessible. Most respondents rated these tools as "Not Accessible," with "Highly Accessible" approaching 0%. Only 2.2% of respondents rated Chemistry Assistant "Moderately Accessible," while 56.9% said "Not Accessible," resulting in a low mean score of 1.1952 and a standard deviation of 0.47311. PhET Interactive Simulations and Labster got low mean ratings of 1.4114 and 1.1952, respectively, and high "Not Accessible" replies (48.6% and 56.5%). Other programs such as MEL Chemistry VR, EduBot, and Explain Everything have poor accessibility ratings, around 1.2. For

instance, 56.3% of instructors rated EduBot as "Not Accessible," resulting in a mean of 1.1712 and a low standard deviation of 0.37723. Desmos Chemistry Tools is the least accessible, with no "Highly Accessible" comments, 7.3% "Somewhat Accessible," and 60.6% "Not Accessible." The mean score was 1.1081 and the standard deviation was 0.31098, indicating limited tool availability. Overall, secondary school chemistry instructors in the region have little access to Generative AI technologies, with ChatGPT being an exception with considerable availability. The lack of AI resources underscores the need to make these educational tools more available so instructors may better incorporate Generative AI into their curriculum.

**Table 3.** Usability level of Generative AI for teaching among secondary school Chemistry teachers in Ilorin Metropolis, Kwara State

SN	ITEMS	HU	MU	SU	NU	MEAN	ST.D
1	ChatGPT is usable in assisting students in understanding chemistry concepts by explaining topics, answering questions, and guiding problem-solving steps.	92	107	134	0	2.873 9	0.81533
2	Chemistry Assistant is use to generate step-by-step solutions for chemical equations, calculate molar masses, predict reactions, and provide structural information, making it a powerful tool for explaining quantitative chemistry problems.	0	9	38	286	1.168 2	0.44105
3	PhET has AI-enabled enhancements that can be used to create simulations for chemical reactions, molecule structures, and states of matter	0	54	42	237	1.450 5	0.75736
4	Labster uses AI-powered virtual labs to create immersive chemistry experiments for students.	0	12	40	281	1.192 2	0.47751
5	MEL Chemistry can be used to provide a virtual reality (VR) experience enhanced by AI algorithms to generate 3D visualizations of chemical processes.	0	0	57	276	1.171 2	0.37723
6	EduBot is an AI-driven tutoring bot that can be used to answer students' chemistry questions in real-time.	0	15	49	269	1.237 2	0.52140
7	DeepChem is an AI-based platform primarily used for molecular modelling and drug discovery, but it has educational applications in visualizing molecular structures, understanding molecular bonding, and exploring reaction mechanisms.	0	0	55	278	1.165 2	0.37189
8	Explain Everything is used to combine AI-powered presentation tools with a whiteboard app, allowing teachers to create interactive and visual chemistry lessons.	0	19	51	263	1.267 3	0.55757
9	Chemventory can be used to generate a variety of activities, from balancing equations to learning chemical properties, providing students with AI-assisted feedback as they work through tasks.	0	0	36	297	1.108 1	0.31098
10	Teachers can use Desmos to generate molecular orbital diagrams, plot titration curves, and explore reaction rates, helping students visualize data and understand quantitative chemistry concepts in real-time.	0	0	36	297	1.108 1	0.31098



Table 3 shows that secondary school chemistry instructors in Ilorin Metropolis, Kwara State, see Generative AI technologies as unsuitable for instructional use, except for ChatGPT. 18.8% of respondents rated ChatGPT "Highly Usable," and 21.8% rated it "Moderately Usable," resulting in a mean score of 2.8739 and a standard deviation of 0.81533. It seems that ChatGPT helps students comprehend chemistry by explaining, answering questions, and directing problem-solving. Other Generative AI programs have even worse usability ratings. For example, 1.8% of instructors rated Chemistry Assistant "Moderately Usable" for solving chemical equations and supporting quantitative chemistry activities, while 58.4% rated it "Not Usable." This input had a mean score of 1.1682, and a standard deviation of 0.44105, suggesting low perceived value.

With a mean score of 1.4505 and a standard deviation of 0.75736, 48.4% of respondents rated PhET Interactive Simulations as "Not Usable," which can simulate chemical processes and molecular structures using AI. AI-powered virtual lab tool Labster has a mean usability score of 1.1922, with 57.3% of instructors rating it "Not Usable." Even worse usability ratings were seen in MEL Chemistry VR, EduBot, DeepChem, Explain Everything, Chemventory, and Desmos. AI-driven virtual reality experience MEL Chemistry VR had no "Highly Usable" evaluations and 56.3% "Not Usable" ratings, resulting in a mean score of 1.1712 and a low standard deviation of 0.37723, suggesting unsatisfactory usability. Chemventory and Desmos scored the lowest at 1.1081, with 60.6% of respondents classifying them as "Not Usable," indicating they are unsuitable for teaching. The findings show that chemistry professors in the area struggle to utilize most Generative AI technologies, except ChatGPT. This suggests the need for more accessible, teacher-oriented AI technologies to improve chemistry education and student engagement with complicated topics.

## Discussion of findings

The findings of this study offer an insightful examination of the awareness and accessibility levels of secondary school chemistry teachers in Ilorin Metropolis, Kwara State, concerning Generative AI tools for teaching. The results highlight a substantial knowledge and accessibility gap, mirroring broader challenges emphasized in the literature regarding the integration of artificial intelligence into education. Existing literature underscores the transformative potential of AI, particularly Generative AI, in revolutionizing education by enhancing teaching strategies, tailoring learning experiences and equipping students for a technology-centric future (Oluyemisi, 2023; Ezugwu et al., 2023). However, this study's findings reveal a concerning reality: a significant majority of teachers display limited awareness of Generative AI. These findings align with the conclusions of Adelana and Akinyemi (2021), who noted a limited understanding of AI technologies among Nigerian educators. Similarly, the results are consistent with global trends, as documented by Lanham and Smith (2025), which identify challenges such as insufficient training, a lack of digital resources, and the absence of institutional policies to guide AI adoption in classrooms.

Regarding accessibility, ChatGPT emerged as the most accessible tool, though only a small proportion of teachers rated it as "Highly Accessible." The mean accessibility score of 2.5886 suggests a moderate familiarity with ChatGPT, while other Generative AI tools, including Chemistry Assistant by Wolfram Alpha and PhET Interactive Simulations, remain largely inaccessible. This finding aligns with Okechukwu et al. (2024) assertion that limited access to digital resources hinders effective AI utilization in science education. The disparity in access underscores the critical need for



targeted investments to equip schools and educators with essential tools for exploring and integrating these technologies. The study further revealed a limited understanding of Generative AI's potential to improve student learning outcomes and its role in curriculum integration. This finding supports observations by Mohebbi (2025), who cautioned that inadequate familiarity with AI's educational benefits could impede its classroom adoption.

Additionally, the lack of awareness about challenges and ethical considerations related to AI applications, such as intellectual property and privacy issues, echoes broader concerns (Olubiyi et al., 2024). Despite these challenges, the transformative potential of Generative AI in education remains significant. Yan et al. (2024) and Mabrouk (2024) demonstrate that Generative AI can enhance teaching by personalizing learning, creating tailored materials, and delivering targeted feedback. The gap identified in this study underscores the urgent need for professional development programs to equip teachers with the requisite knowledge and skills to effectively utilize Generative AI tools in their instructional practices. While Generative AI presents substantial opportunities to improve secondary education, its advantages remain largely untapped among chemistry teachers in Ilorin Metropolis. Bridging this gap requires collaborative efforts to provide comprehensive training, adequate resources, and supportive policy frameworks to foster the successful integration of AI into educational systems. Such initiatives can empower educators to leverage AI's potential, thereby advancing teaching and learning outcomes and aligning with the transformative goals advocated by scholars like Onyejelem and Aondover (2024).

## CONCLUSION

The study concludes that secondary school chemistry teachers in Ilorin Metropolis, Kwara State, encounter considerable difficulties with the accessibility and usability of Generative AI tools for teaching. The findings highlight a significant lack of awareness regarding the potential applications, benefits, and integration of Generative AI in the classroom. This lack of understanding emphasizes the need for focused professional development programs that can enhance teachers' knowledge of how these technologies can improve teaching and be effectively incorporated into educational practices. Furthermore, the study indicates that, in general, Generative AI tools are not readily accessible to chemistry teachers in the region, with ChatGPT standing out as the only exception, demonstrating comparatively better access. The limited availability of such tools underscores the urgent need to expand access to a wider variety of AI resources designed for educational purposes. Improving access would allow teachers to incorporate these technologies more effectively into their teaching strategies, thereby enhancing the overall learning experience. In addition, the low usability scores for most Generative AI tools suggest that, beyond ChatGPT, teachers face challenges in integrating these technologies into their instructional methods. This highlights the importance of developing more user-friendly, accessible AI tools that meet the specific needs of chemistry education. Overall, the study calls for improvements in both the accessibility and usability of Generative AI tools in education, to better support teachers and foster student engagement with complex chemistry concepts. Based on the findings of this study, the following recommendations are proposed:



1. Educational authorities should integrate Generative AI into teaching practices to establish professional development programs for secondary school chemistry teachers in Ilorin Metropolis.
2. Schools and educational authorities should increase access to these tools with the necessary infrastructure, including reliable internet connections and appropriate devices.
3. Educational authorities should press the need to develop more user-friendly and teacher-oriented AI resources for chemistry education.

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