



Teachers' Awareness and Application of Artificial Intelligence for Teaching Science Education in Kaduna State College of Education, Gidan Waya, Nigeria

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Abstract

The paper aimed to assess academic staff's level of awareness and application of artificial intelligence (AI) for teaching Science Education in Kaduna State College of Education, Gidan Waya, Nigeria. Descriptive survey research design was used for the study. Three research questions guided the study. The population of the study comprised of all 135 teaching staff in School of Science Education, Kaduna State College of Education, Gidan Waya. Sample of 70 teaching staff were randomly selected across all departments using simple random sampling. Artificial Intelligence Science Education Teachers' Awareness Questionnaire (AISETAQ) was used for data collection. The instrument was subjected to face validity by three experts. The internal consistency reliability method was used and Cronbach Alpha reliability was applied which yielded 0.78. Data were analysed using frequency count and simple percentage. Findings showed that although most academic staff were aware of AI, very few applied AI in teaching. Result also showed that several factors such as lack of knowledge about AI and AI tools, inability to download or access AI tools, poor network, inadequate electricity, lack of adequate gadgets for applying AI in teaching were some militating factors affecting the application of AI in teaching. The study recommended among others; workshops and seminars be conducted by government from time to time to update academic staff with trends on the application of AI in teaching. Government should provide sufficient gadgets at departmental levels for effective teaching using AI.

Key words: Teachers' Awareness, AI, Application, Science Education

Introduction

Awareness is a concept referring to having knowledge of something or being cognisant of an event/ situation. Awareness means acknowledging the existence of something or event. In the words of Abdulrafiu, Makinde, Sakariyahu, and Apo (2024), awareness is the state of having knowledge of the existence and usefulness of something. Teachers need to appear to have an idea about Artificial intelligence (AI) before being able to apply it in their teaching. AI is a field of science concerned with building computers and machines that can reason, learn, and act in such a way that would normally require human intelligence or that involves data whose scale exceeds what humans can analyze. It is the simulation of human intelligence processes by machines, especially computer systems (Hermansyah, et al., 2023). Though, AI has flourished in numerous domains

within the education system, a comprehensive analysis of its role, advantages, and challenges in science education must be further explored through empirical investigations. The knowledge gap might prompt teachers, policy makers, and educational administrators to base decisions on patchy as well as limited information, lacking potential opportunities to enhance science teaching and learning with the help of AI (Pima, 2019). To fill this gap, the present paper provides a review that examines and consolidates AI's impact on the teaching of science education.

Artificial Intelligence in education (AIEd) is an evolving interdisciplinary arena incorporating AI technologies to renovate and enhance teaching and learning environments. Particularly, the application of AI in science teaching and learning is becoming more popular, even as interest in AI's effects on

general education is growing (Chiu et al., 2023; Gonzalez, et al., 2017). Popenici and Kerr (2017) conducted a study to investigate the impact of AI on the teaching-learning process in higher education settings. Their study focused on how intelligent technologies are affecting student learning and traditional teaching approaches in education. Their research presents valuable insights into the incorporation of AI within science education contexts. Zawacki-Richter, et al. (2019), in their systematic assessment of AI application in higher education, focused on the vital role that teachers can play in this domain. The results showed how important it is to explore and understand the needs and perceptions of teachers when integrating these technologies into teaching-learning settings.

Science education is the teaching of science to school children, college students, or adults within the general public. It is the field of science that is concerned with sharing of science content, science process (the scientific method), some social science, and some teaching pedagogy in order to provide expectations for the development of understanding part of the scientific community (Paul, 2020). Science education has the potential for helping the development of the required abilities and understanding by focusing on developing powerful ideas of science and ideas about the nature of scientific activity and its applications.

The goal of science education is not only to teach scientific knowledge but also to develop a scientifically literate populace capable of engaging in scientific reasoning and decision-making. This aligns with the “Science for All” movement, emphasizing the importance of science education for all students, not just those pursuing careers in science (Almasri, 2021). Students’ scientific literacy and critical thinking abilities are developed through the teaching and learning of scientific theories, procedures, and experiments in science education (Alharbi, et al., 2022). It is essential for developing students’ foundational knowledge, intriguing their curiosity, and getting them ready for STEM careers as per the contemporary world’s needs. Through AI incorporation, science education can be made more interesting, approachable, and pertinent for students of all ages and backgrounds by emphasizing experimental learning. With AI technology’s continuous evolution and popularity, the possibilities for its application in science education are promising but not without challenges (Persia, et al., 2020). AI has the capability to transform the way science is taught and learned. One of the most compelling applications of AI in science education is its ability to simulate scientific experiments and provide virtual

laboratory experiences to science learners. This ensures that students can practice and develop their scientific skills in a safe and controlled environment, potentially saving expenses and offering new opportunities for exploring scientific concepts that may not be feasible in traditional laboratory settings (Wahyoo, et al., 2019). However, according to Tang and Cooper (2024), these virtual experiences may lack the tactile and hands-on aspects of interaction with the physical world which are crucial for certain types of learning.

By leveraging AI, educators can also move away from traditional, one-size-fits-all approaches to education and instead provide personalized and interactive learning experiences for students. Kafyulilo, et al., (2018) observed that the effectiveness of these personalized learning systems depends heavily on the quality and representativeness of the data they are trained on, which can sometimes introduce biases and perpetual existing inequities. In addition, students can also benefit from immediate feedback and adaptive learning pathways, ensuring that they are able to address any misconceptions or gaps in their understanding of scientific phenomena (Mavroudi, et al., 2018). AI can also help science educators track and monitor students’ progress more effectively, allowing for targeted interventions and support where necessary. Moreover, the use of AI can enable the development of interactive and immersive learning environments, making science education more engaging and accessible to students with diverse learning styles and needs (Pima, 2019). As AI continues to advance, the potential for its integration into science learning is likely to grow, presenting exciting opportunities to transform and elevate the science education experiences for students at all levels (Park, et al., 2023).

Another significant contribution is the improvement of exploratory learning through virtual labs and reenactments (Mahmoud, 2020). AI-powered instruments have the potential to recreate complex logical tests, which may be illogical or hazardous to conduct in a conventional classroom setting. These virtual situations offer hands-on learning encounters and permit understudies to try distinctive scenarios, improving their understanding of scientific concepts (Ibanez, et al., 2018). This approach was not as supportive of extending understudy engagement but too valuable to democratize access to high-quality science instruction. This interconnecting also permits integrating differing datasets into the educational modules, uncovering understudies to real-world logical challenges and datasets (Holmes, et al., 2023).

Studies on the investigation of factors affecting teachers' adoption of AI in science education abound but with the divergent reasons. Lack of AI resources as a factor affects the use of AI (Kafyulilo et al., 2018 & Pima, 2019). Teachers are not trained and do not have the technical support required to use AI (Mahmoud, 2020). Teachers find AI very difficult to use and so do not adopt it (Hong et al., 2022). Computer self-efficacy affects teachers' use of AI (Tang & Cooper, 2024). When teachers lack the basic knowledge of the availability and usage of AI-based teaching methods, it can affect their adoption (Lawrence & Tar, 2018). The study sought to examine academic staff's level of awareness of the application of AI in teaching science education.

Statement of the Problem

Over the years, there has been an outcry to incorporate AI in education. This was not intended to replace the teacher but to assist the teacher in teaching and learning. A lot of researches and workshops have been conducted on the application of AI in science education. Therefore, this paper intends to investigate the application of this knowledge in science education. Although, AI has flourished in numerous domains within the education system, a comprehensive analysis of its role, advantages, and challenges in science education must be further explored through empirical investigations. The knowledge gap might prompt teachers, policymakers, and educational administrators to base decisions on patchy as well as limited information, lacking potential opportunities to enhance science teaching and learning with the help of AI. To fill this gap, the present research provides a systematic review that comprehensively examines and consolidates AI's impact on science education.

The Nigerian education system has suffered from a lot of setbacks. A beautiful curriculum will be designed but it will crash at the point of implementation. The curriculum of science education was designed particularly to encourage students' participation. Hence, incorporating AI into teaching and learning spaces will be capable of enhancing students' performance. Therefore, science teachers are expected to have some level of competencies to be able to incorporate AI during the teaching of science. It thus become necessary to undertake a study on the impact of AI and factors that influence its application in teaching and science education.

Purpose of the Study

The paper aimed to examine the impact of Artificial Intelligence (AI) as a driven force in science education. Specifically, the study investigates:

1. Academic staff's level of awareness of AI for teaching science education.
2. The level of application of AI in teaching science education.
3. The challenges encountered in utilizing AI for teaching and learning of science education?

Research Questions

The study is guided by the following research questions:

1. To what extent are academic staff aware of the use of AI for teaching science education?
2. What is the level of application of AI for teaching science education?
3. What are the challenges encountered in utilizing AI for teaching and learning of science education?

Method

The study employed the descriptive survey research. This is because it enabled researchers to gather data from a large population. The study is guided by three research questions. The population of the study is made up of all 135 lecturers comprising of 70 females and 65 males. Furthermore, simple random sampling was used to obtain a sample of 70 lecturers across the seven departments, namely: Chemistry, Physics, Biology, Integrated Science, Physical and Health Education, Computer Science, and Mathematics Education. The Instrument for data collection is Artificial Intelligence Science Education Teachers' Awareness Questionnaire (AISETAQ). The instrument was developed by the researchers and is made up of four sections. Section 'A' consist of the respondents' demographic information, Section 'B' consists of 5 item statements verifying the respondents' knowledge of AI. Section 'C' consists of 8 item statements which examine available materials for the application of AI in teaching science education. Section 'D' consists of 8 item statements which examine possible challenges in the application of AI for teaching science education among academic staff. The instrument was subjected to face validation by three experts from the Department of Integrated Science and Mathematics KSCOE, Gidan Waya. The internal consistency reliability method was used and Cronbach Alpha reliability was applied that yielded 0.78 which made the instrument reliable. The data collected from the respondents were analyzed using frequency count and simple percentage.

Table1: Population and Sample Distribution of Academic Staff for the Study.

S/No	Department	Population	Sample
01	Integrated Science	15	10
02	Chemistry	22	10
03	Physics	17	10
04	Biology	28	10
05	PHE	15	10
06	Computer Science	24	10
07	Mathematics	14	10
	Total	135	70

Source: Heads of Departments Office, 2024/2025 academic session, School of Secondary Education (Science Programmes) Kaduna State College of Education, Gidan Waya.

Results

Research Question One: To what extent academic staff have knowledge on the use of AI for teaching science education?

Table1: Percentage rating of academic staff knowledge of AI for teaching science education.

S/No	Item Statement	Yes		No	
		f	%	f	%
1.	Are you familiar with AI for teaching?	17	(24.28)	53	(75.72)
2.	Are you aware of AI tools for teaching?	0	(0.0)	70	(100)
3.	Have you used AI?	0	(0.0)	70	(100)
4.	Given the opportunity will you like using AI to teach?	70	(100)	0	(0.0)
5.	Have you ever attended a training on using AI to teach?	15	(21.42)	55	(78.57)

Table 1 shows that all the respondents 70 (100%) are not currently using AI to teach nor using AI to give and mark assignments. Even though 17 (24.28%) respondents are familiar with AI tools for teaching.

The table shows that all the respondents 70 (100%) indicates interest if given the opportunity to use AI for teaching, only 15 (21.42%) have ever attended training on using AI to teach.



Research Question Two: To what extent are there available materials for the application of AI for teaching and learning of science education?

Table 3: Percentage rating of available materials for the application of AI in teaching and learning science education.

S/No	Item Statement	Yes f	%	No f	%
1.	Do you have a personal computer/laptop?	70	100	0	0.0
2.	Is there computer lab in the department/school?	0	0	70	100
3.	Is the lab equipped with adequate computers?	0	0	70	100
4.	Do you have a personal projector?	0	0	70	100
5.	Are there projectors in the department/school?	0	0	70	100
6.	Are the projectors adequate to use?	0	0	70	100
7.	Do you use computer/projector?	0	0	70	100
8.	Is there available electricity in the department/school for using the computer/projector?	0	0	70	100

Table 3 indicated that all 70 (100%) academic staff have personal computer/laptop while none has personal projector. The table also shows that there are no available materials such as computers, projectors

and electricity in the department/school for the application of AI for teaching and learning of science education as indicated by the respondents.

Research Question Three: What are the challenges encountered in utilizing AI for teaching and learning of science education?

Table 4: Percentage rating of academic staff perceived challenges in using AI for teaching science education.

S/No	Item Statement	Yes f	%	No f	%
1.	Lack of adequate training on how to source and apply AI tools for teaching.	70	100	0	0.0
2.	Lack of technicians to manage AI tools	42	60	28	40
3.	Lack of basic knowledge and usage of AI-based teaching methods.	62	88.57	8	11.43
4.	Lack of network for downloading AI materials	20	28.57	50	71.43
5.	Inadequate supply of electricity	70	100	0	0.0
6.	Lack of funding for supplies and repairs of AI tools	70	100	0	0
7.	AI tools are difficult to maintain and purchase.	64	91.43	6	8.57
8.	Downloading AI materials consumes money	70	100	0	0

Table 4 shows the following as the major challenges in using AI in teaching: 70 (100%) respondents indicated that lack of adequate training on how to source and apply AI tools for teaching, 42 (60%) lack of technicians to manage AI tools, 62 (88.57%) lack of basic knowledge and usage of AI-based teaching methods, 20 (28.57%) lack of network for downloading AI materials, 70 (100%) inadequate supply of electricity, 70 (100%) lack of funding for supplies and repairs of AI tools, 64 (91.43%) AI tools are difficult to maintain and purchase and 70 (100%) indicated that downloading AI materials consumes money.

Discussion of Findings

Results in Table 1 revealed that all the respondents 70 (100%) are not currently using AI to teach nor to give and mark assignments. This could be as a result of lack of basic knowledge on how to source and apply AI tools for teaching. This result agreed with the findings of Lawrence and Tar, (2018) who observed that teachers lack the basic knowledge of the availability and usage of AI-based teaching methods affect their adoption. Teachers are not trained and do not have the technical support required to use AI (Mahmoud, 2020). Teachers find AI very difficult to use and so do not adopt it (Hong, et al. 2022).

Table 3 shows that there are no available materials such as computers, projectors and electricity in the department/school for the application of AI for teaching and learning of science education. This finding agreed with the findings of Dai, (2023) that lack of AI resources is a factor affecting the use of AI in teaching.

Table 4 indicated the following as the major challenges in using AI in teaching: lack of adequate training on how to source and apply AI tools for teaching 70 (100%), 42 (60%) lack of technicians to manage AI tools, 62 (88.57%) lack of basic knowledge and usage of AI-based teaching methods, 20 (28.57%) lack of network for downloading AI materials, 70 (100%) inadequate supply of electricity, 70 (100%) lack of funding for supplies and repairs of AI tools, 64 (91.43%) AI tools are difficult to maintain and purchase and 70 (100%) indicated that downloading AI materials consumes money. This is in agreement with the findings of Kafyulilo et al. (2018); Dai, (2023); Hong et al. (2022); Zhai, He, and Krajcik (2022).

Conclusions

In conclusion, Artificial Intelligence has numerous benefits in science education, profoundly affecting teaching and learning. AI programs can study how students learn and change the material to fit each student's needs, skills, and the way they learn. This way of creating educational material helps students learn better and faster. It helps them go at their own pace and in a way that matches how they like to learn. Also, AI-powered data analysis can help science teachers understand how well their students are doing in specific scientific subjects and where they might need extra help.

Recommendations

Based on the findings, the study recommended the following:

1. There should be workshop and seminar to enlighten teachers on using AI to teach, give, and mark assignments.
2. There should be adequate and functional computer labs equip with computers, projectors and standby generator or uninterrupted electricity at the departmental and school level for staff and students to use.
3. Workshops and seminars should be organized by government from time to time to update academic staff on the need to utilize AI tools in teaching. During the workshop/seminar, staff can also learn basic knowledge how to source, organize and use AI-based teaching methods.

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