



Physics Teachers' Awareness of the Application of Artificial Intelligence in Teaching and Learning of Physics in Senior Secondary Schools in Nsukka Education Zone

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Abstract

The study examined Physics teachers' awareness of the Application of Artificial Intelligence in Teaching and Learning Physics in Senior Secondary Schools in Nsukka Education Zone of Enugu State. The study adopted a descriptive survey research design. The study population comprised all 37 Physics teachers (26 males and 11 females) in the Zone. The Artificial Intelligence Awareness Questionnaire (AIAQ) was used for data collection. The instrument was face-validated and trial-tested to ascertain its internal consistency reliability, using Cronbach's alpha, which yielded a reliability index of 0.79. The data collected from the participants were analysed using descriptive statistics. The results showed that the level of Physics teachers' awareness of AI in teaching Physics was moderate. It also showed that there were no statistically significant differences in the mean scores of male and female teachers on their awareness of the application of artificial intelligence in teaching and learning Physics in senior secondary school. This means that the male and female teachers do not differ in their level of awareness of AI. Moreover, it was found that teachers are interested in the use of AI in the classroom, but are handicapped in terms of how to use the AI tools. Thus, the researchers recommend that teachers should be trained on the use of AI in teaching and learning.

Keywords: Artificial intelligence (AI), Teacher awareness, Physics teaching and Learning.

Introduction

The speed at which digital technologies are developing creates a strong force for teachers to enhance their digital competence. The realization of the potential educational benefits of artificial intelligence (AI), has called for the active and meaningful engagement of teachers, students and school leaders in the use of artificial intelligence. Artificial intelligence (AI) allows students to learn at anytime and anywhere in the world and provides flexibility in presenting scientific material to suit students' abilities and provides students and teachers with feedback (Al-Atl & Al-Anzi, 2021). The growth of artificial intelligence (AI) has increased exponentially within the last few decades, and students and teachers must embrace the latest in AI and its application in teaching and learning to keep up with the pace of AI.

Artificial intelligence and its applications have a role in improving and developing all areas of life,

through the development of computer systems to operate with superior efficiency similar to the competence of an expert human being (Mahmoud, 2020). Holder, Khurana and Watts (2018) defined AI as a group of computer science technologies that enable systems to perform tasks that usually require human intelligence, such as visual perception, speech recognition, decision-making, and language translation. AI is a product of human intelligence and decision-making and therefore does not exist independently of humans (Zarrouki & Falata, 2020). AI is a set of methods and systems capable of performing various tasks that simulate the capabilities of human intelligence, such as thinking, analysis, learning, and problem-solving (Alissa & Hamadneh, 2023). Artificial intelligence can also contribute to the development of science curricula by continuously updating lessons and presenting them to students in a manner commensurate with their needs and abilities



(Al-Qutaish, 2022). Artificial intelligence applications can make the learning environment a smart environment by helping the teacher to analyze students' learning behavior and provide them with appropriate support (Shute & Zapata-Rivera, 2022). AI also provide analysis and support to help teachers improve their teaching methods and real-time assessment of the impact of learning activities on student engagement and academic outcomes (Zarrouki&Falata, 2020). According to Kautz, Etzioni and Mooney (2021), AI assesses students and knows their level and increase the creative and imaginative ability of the student, using graphic and photographic programs in highlighting the scientific material.

The emerging literature on the use of AI in scientific practices includes a study by Mahmoud's (2020) who reported that AI played diverse imminent roles in education and stated that when AI is incorporated into the teaching and learning system, it creates chances for improvement in the educational section in terms of teachers' teaching and students' learning outcomes. Man (2021) examined the opportunities and challenges faced by educational leadership based on artificial intelligence in the field of education in China by classifying the advanced global progress of artificial intelligence in education and analyzing the latest theoretical and practical results of artificial intelligence in education. The results showed that the opportunities brought by artificial intelligence in education are greater than the challenges. Al-Atl and Al-Anzi (2021) identified the importance of artificial intelligence technology in the educational process and the challenges facing its use in education in the State of Kuwait. The results showed that artificial intelligence technology has importance in the educational process. Hwang et al. (2021) carried out a study on factors affecting the adoption of AI in higher education indicated that 7/10 of teacher willingness to adopt AI was attributed to self-efficacy, anxiety, usefulness, and comfort of use. Al-Roumi and Al-Qahtani (2023) conducted a study aimed at determining the skills of employing artificial intelligence applications in improving learning outcomes for secondary school students in Saudi Arabia. The study concluded that the high role of the skills of employing artificial intelligence applications in improving student learning outcomes and the weakness of applied reality in secondary schools. Wang et al. (2023), explores the ways in which AI is now helping scientists in 'asking new questions' and generating new hypotheses in particle physics,

materials science, biology, chemistry and other fields leading to the 'planning and carrying out investigations and found that AI is now enabling scientists to generate new hypotheses and design investigations that would not have been possible with traditional scientific methods alone.

Some of the artificial intelligent used in education includes interactive or AI-powered chatbots, augmented reality, virtual reality applications, Intelligent tutoring system, Learning analytics dashboards, Adaptive learning systems, the Internet of things in educational situations and so on (Al-Qahtani& Al-Dayel, 2021). Augmented reality (AR) and virtual reality (VR) are becoming increasingly more popular in students' everyday lives, so by teachers applying these technologies as a learning tool in the classroom will help the students to gain valuable experiences. Teachers can use AR and VR to create expansive opportunities for students to view and understand concepts in new and captivating ways, and can also create an additional, interactive and collaborative avenue of learning for students. Intelligent tutoring system is software that gets information on the student as the student progresses with it and can deduce the learner's level of competence or incompetence (Olaogun & Oyediran, 2023). Learning analytics dashboards is an application that indicates learners' online conducts patterns in a virtually simulated instructional environment and also monitors learners' log files (Park & Jo, 2020). Teachers can use AI to deliver individualized lesson plans, exercises, and resources that are suited to each student's needs by integrating adaptive learning platforms (Fitria, 2021), which can improve comprehension and retention by allowing students to advance at their own speed. AI-powered chatbots and virtual assistants can provide Physics students with rapid access to information, explanations, and resources linked to science topics (Ghorashi et al., 2023). Teachers can also use Adaptive Learning Systems to adjusting the course contents and the learners' ability to improve students' learning outcomes in both teachers' instruction and machine learning (Capuano & Caballé, 2020). AI tutoring systems provides Personalized guidance, assistant, and evaluation by tailoring learning content based on student-specific learning patterns or knowledge levels (Hwang et al., 2020). Physics teachers in Nsukka Education Zone of Enugu State are interested in the use of AI in the classroom but are handicapped in terms of how to use the AI tools, lack of AI resources,

the heavy workload of Physics teachers, lack of technical support required to use AI, lack of computer literacy. If Physics teachers are not aware of the availability and usage of AI-based teaching methods, it can affect their application of AI in teaching and learning of Physics.

Physics is the science that deals with the structure of matter and the interactions between the fundamental constituents of the observable universe (Knight, 2016). Physics is a core subject in the school curriculum that deserves serious attention. The application of Artificial Intelligence (AI) in teaching Physics has power of transforming conventional pedagogical methods, resulting in more personalized, effective, and engaging learning experiences. With AI, Physics teachers may tailor teaching and learning to the needs of each student, encourage critical thinking, and provide prompt feedback. AI in science education has exciting opportunities to raise student interest, boost instructional effectiveness, change the way knowledge is acquired, and promote a deeper comprehension of scientific ideas (Almusaed et al., 2023). Engaging Physics students in AI education will not only fosters critical thinking and problem-solving skills but will also stimulate creativity and innovation among the students. Physics is among the subjects that have their place in the educational system and are of particular importance among other subjects. It is imperative to diversify the methods of presenting Physics learning by the teachers to suit the learners need. Hence, there is need to examine the Physics teachers' awareness on the application of Artificial Intelligence in Physics Teaching and Learning.

Teacher awareness of Artificial Intelligence is very important for ensuring the effective use of AI technologies in teaching and learning. The integration of AI in teaching and learning requires teachers to be aware of these technologies in order to use them effectively in the classroom. As the use of AI is increasing in education, there is need to understand the level of Physics teachers' awareness of AI. This awareness is essential for teachers to know how to use AI tools and integrate them into classroom practices effectively (Ipek et al., 2023). Measuring teachers' awareness of AI is essential for ensuring that educators are prepared to leverage the potential of AI in education, to equip students for the future (Yau et al., 2022), and to address the ethical and societal implications of AI technology (Adams et al., 2022). Ng et al. (2023) emphasize the need for more comprehensive studies on AI literacy in the context of

teacher education. This highlights the importance of examining teachers' levels of awareness regarding AI technologies. AlKanaan (2022) explored pre-service science teachers' awareness of AI using a mixed-method approach, the study revealed that teachers' awareness levels were generally low. Uygun, Aktas, Duygulu and Koseer (2024) Exploring teachers' artificial intelligence awareness and found that teachers' AI awareness was at a moderate level. Aliyu (2024) examined the Teachers' Awareness and Perception on Utilization of Artificial Intelligence as a Tool for Teaching and Learning of Chemistry at Secondary Schools in Sokoto State and the findings revealed a low level of teachers' awareness regarding AI tools in chemistry education, with most teachers lacking familiarity with AI applications in their teaching. Examining teachers' awareness of AI is vital for preparing teachers (Physics teachers) to effectively integrate AI technologies into teaching practices, adapt to changing educational paradigms, and ensure that students receive a quality education that leverages the benefits of AI. Based on these discrepancies on the literature reviewed, the present study seeks to examine the Physics teachers' awareness of AI and investigate whether this awareness varies based on gender.

Gender refers to the roles, responsibilities, expectations and characteristics of males and females that are created in families, cultures and societies. Gender is the range of physical, biological, mental and behavioural characteristics pertaining to and differentiating between masculinity and femininity (Nakano, 2017). Gender is the socially and culturally constructed characteristics, qualities, behaviors and roles which the different societies ascribe to females and males. Empirical studies conducted by Darayseh (2023) which examined the Acceptance of artificial intelligence in teaching science: Science teachers' perspective and found a statistically significant difference in teacher responses based on the variables gender in the use of AI in science teaching. Güneyli, et. al (2024) Exploring Teacher Awareness of Artificial Intelligence in Education: A Case Study from Northern Cyprus. The study findings revealed no significant influence of teacher gender on AI awareness. In the case of gender, there is controversy in the researcher's findings. Based on these discrepancies, the present study seeks to find if any differences will emerge based on gender. From the studies reviewed, none of the studies conducted locally and internationally focused on examining Physics Teachers' Awareness on the Application of Artificial

Intelligence in Teaching and Learning of Physics in Senior Secondary Schools in Nsukka Education Zone of Enugu State using gender as a moderating variable, therefore, the present study seeks to fill the gap.

Most of the literature reviewed was carried out in outside Nigeria and their results show that AI was effective in teaching and learning. To ensure Nigeria's educational sector is at par with global standards, stakeholders in Nigeria's education sector have urged the Federal Government to include Artificial Intelligence (AI), as one of the global emerging technologies, in school curricula across the country. They pointed out that, if AI was adopted, it would adequately make for an easy learning experience for the learners and make teaching on the part of teachers easy and dynamic. It is time to get our Physics teachers ready and aware for AI application in teaching and learning.

Statement of the Problem

It is obvious from the literature that AI application in science especially in Physics teaching and learning is lagging behind as evident by the scanty literature reviewed. Literature reviewed also indicated that AI is gaining ground in other continents like Europe, America, and some Africa countries but Nigeria is left behind. Physics teachers are expected to have some level of awareness on the application of AI to be able to incorporate AI during teaching and learning of Physics. It is important that teachers and learners, to engage confidently, critically and safely with AI systems to provide them with the necessary knowledge and skills to live in a world surrounded and shaped by AI. To ensure Nigeria's educational sector is at par with global standards, stakeholders in Nigeria's education sector have called for inclusion of Artificial Intelligence (AI), as one of the global emerging technologies, in school curricula across the country. In this curriculum, teachers are the ones to implement it, and the question is 'Are Nigerian teachers especially Physics teachers in Nsukka Education Zone of Enugu state aware on how to implement the AI curriculum when put in place? There is, therefore, the need to examine the Physics teachers' awareness on the application of artificial intelligence in Teaching and Learning of Physics in Senior Secondary School in Nsukka Education Zone of Enugu State.

Purpose of the Study

The study examined the Physics teachers' awareness on the Application of Artificial Intelligence

in Teaching and Learning of Physics in Senior Secondary Schools. Specifically, the study aimed to determine:

1. the level of Physics teachers' awareness on application of artificial intelligence in teaching and learning of Physics in senior secondary school.
2. the influence of gender on Physics Teachers awareness on application of artificial intelligence in teaching and learning of Physics in senior secondary school.

Research Questions

The following research questions were posed for the study:

1. What is the level of Physics teachers' awareness on application of artificial intelligence in teaching and learning of Physics in senior secondary school?
2. What is the influence of gender on Physics Teachers' awareness on application of artificial intelligence in teaching and learning of Physics in senior secondary school?

Hypotheses

The following lone null hypothesis was tested at 0.05 level of significance.

H₀: There is no significant influence of gender on Physics Teachers' awareness on application of artificial intelligence in teaching and learning of Physics in senior secondary school.

Method

Design of the Study

This study employed a descriptive survey research design to examine the Physics teachers' awareness on the Application of Artificial Intelligence in Teaching and Learning of Physics in Senior Secondary Schools in Nsukka Education Zone of Enugu State.

Participants

The population of the study comprised all the Physics teachers in the zone which consist of 37 (26 males and 11 females) Physics teachers. Because the population size was manageable, there was no need for sampling.

Instrument for data collection

Artificial Intelligence Awareness Questionnaire (AIAQ) was used for data collection.

The instrument was adapted from Alissa and Hamadneh (2023). It was used to measure the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process with 20 items. Some modifications were done on science and mathematics teachers' employment of artificial intelligence applications to meet the demand of the present research in terms of language structures and subject matter. The present study was on Physics Teachers awareness on the Application of Artificial Intelligence using Artificial Intelligence Awareness Questionnaire (AIAQ) with four-point scale of Strongly agree (4), Agree (3), Disagree (2), Strongly disagree (1). The Artificial Intelligence Awareness Questionnaire (AIAQ) instrument has sections "A" and "B", Section A contained personal data of the Physics teachers while Section B consist of 15 items that measured Physics Teachers' awareness on the Application of Artificial Intelligence. The instrument has a minimum point of 15 and maximum point of 100. AIAQ was face validated by three (3) experts in Science Education University of Nigeria, Nsukka. Their comments and suggestions were incorporated into the final stage of the AIAQ. To ascertain the

internal consistency of the items in the AIAQ, the instrument was administered to 20 Physics teachers in Obollo-Afor Educational Zone who did not take part in the study but were equivalent to Physics teachers who were used for the study. The reliability of the instrument was sought to measure how consistent the instrument was using Cronbach's alpha and obtained 0.79.

Method of Data Collection

Face to face method was used to collection data from the participants. The researcher gave the participant time to responds to the items after which the researcher collected the instruments back.

Method of Data Analysis

The data were analyzed using mean and standard deviation, independent sample t-test, and Cronbach alpha coefficient. The means of the respondents' responses to the items were judged, a four-point Likert scale was adopted and the mean values were determined as follows: less than (1.0 - 1.49) low, (1.5 - 2.49) moderate, (2.5 - 3.49) high, (3.5 - 4.0) very high.

Results

Table 1

Means analysis of the levels of Physics teachers' awareness on application of artificial intelligence in teaching and learning of Physics in senior secondary school

Item Statement	Mean	Std. deviation	Remark
1. I know how to use artificial intelligence translation apps like Google in solving Physics problems	2.83	1.12	High
2. I know how to prepare my Physics lesson activities Using artificial intelligence technology that take into Account individual differences among students	2.37	1.11	Moderate
3. I know how to create Physics lessons with smart digital content using artificial intelligence	2.29	1.08	Moderate
4. I know how to use AI in writing my Physics notes.	2.32	1.17	Moderate
5. I can use software like intelligent tutoring system that has part of AI incorporated into it in teaching Physics	2.65	.98	High
6. I know how to monitor Physics student's log files using AI tools	2.43	1.21	Moderate

7. I can use Labster visual and PhET simulation in teaching Physics.	1.27	.11	Low
8. I do not have the technical support required to use AI in teaching Physics	2.46	.84	Moderate
9. I know how the ethical impact of AI systems is assessed in the school	2.43	1.17	Moderate
10. I can use Internet of Things technology to complete my Physics tasks faster	2.33	.99	Moderate
11. I can use AI tools to address Physics student's diverse learning needs.	2.41	.87	Moderate
12. I can provide feedback to students using artificial intelligence applications	2.92	1.01	High
13. I can analyze exam results using artificial intelligence applications.	2.46	1.07	Moderate
14. The concept of Artificial Intelligence is well familiar to me	2.21	1.07	Moderate
15. I can interact with Cahbot	2.84	.96	High
Overall Mean	2.41	.98	Moderate

The results in Table 1 show that the average level of Physics teachers' awareness on application of artificial intelligence in Physics teaching and learning came to a moderate degree with a mean of (2.41) and a standard deviation (0.98). Item (12) "I can provide feedback to students using artificial Intelligence applications" ranked first with a mean of (2.92), a standard deviation of (1.01), and a high degree. The rest of the items of teachers' awareness on the

application of artificial intelligence in teaching Physics that came with a high and moderate degree talk about the use of AI tools in Physics teaching and learning. Item (8) "I can use Labster Virtual and PhET simulation in teaching Physics" ranked last, with a mean of (1.27), a standard deviation of (0.11), and a low degree. It also includes creating Physics lessons with smart digital content using artificial intelligence.

Table 2

Mean analysis of the Influence of Gender on Physics Teachers' Awareness on the Application of Artificial Intelligence in teaching and learning of Physics

Gender	Mean	SD	t	df	p-value	Decision
Male	26	2.96	0.35	1.594	35	0.112
Female	11	2.91	0.41			Not Sig.

*N = Number of participants, SD = Standard Deviation

Table 2 shows the means and standard deviations of male and female Physics teachers based on their awareness of AI in teaching and learning Physics. The result shows that the male teachers had a

mean score of ($M = 2.96$, $SD = 0.35$) while female counterparts had a mean score of ($M = 2.91$, $SD = 0.41$). This shows that the male teachers had a slightly

higher mean score than their female counterparts on awareness of AI.

H₀: There is no significant influence of gender on Physics Teachers' awareness of application of artificial intelligence in teaching and learning of Physics in senior secondary school.

Table 2 reveals that there is no significant difference in the mean scores of male and female teachers with respect to their awareness of AI, $t(35) = 1.594$, $p = 0.112$. This means that the gender does not influence Physics Teachers' awareness of the application of artificial intelligence in teaching and learning of Physics in senior secondary school.

Discussion

The discussions of the findings were done based on the objectives of the study. The first finding indicated that there is moderate level of teachers' awareness on the application of AI in teaching and learning of Physics at secondary schools in Nsukka Education Zone of Enugu state. This implies that teachers possess a certain knowledge and awareness about AI but could gain more knowledge in the area. A moderate level of awareness suggests that teachers have the potential to integrate AI technologies into teaching and learning processes. This finding is in line with that of Zhao et al. (2022) whose study found that most of the teachers have a moderate to high level of AI literacy, indicating a relatively in-depth understanding of the use of AI resources in the classroom. On the other hand, Uygun, Aktas, Duygulu and Koseer (2024) found that teachers' AI awareness was at a moderate level. The present study is in contrast with the study of Aliyu (2024) who examined the Teachers' Awareness and Perception on Utilization of Artificial Intelligence as a Tools for Teaching and Learning of Chemistry at Secondary Schools in Sokoto State and the findings revealed a low level of teachers' awareness regarding AI tools in chemistry education, with most teachers lacking familiarity with AI applications in their teaching. Also, Güneylit et al. (2024) who examined the level of awareness among teachers regarding the use of AI in education in Northern Cyprus, focusing on whether this awareness varies according to socio demographic characteristics, access to technology, and specific knowledge and beliefs about AI. Their Findings revealed low level AI awareness among teacher most particularly at primary and secondary levels of education. Due to the different

results in the literature regarding teachers' awareness of AI, it is also necessary to examine the result of the present study.

Conclusion

The Physics teachers' awareness of the application of AI in secondary schools in teaching and learning of Physics in Nsukka Education Zone of Enugu State has shown promising potential, but also has significant challenges in terms of how to use the AI tools. The findings indicate that there is a moderate level of Physics teachers' awareness regarding AI as a tool for teaching and learning, highlighting the potential of AI to make Physics teaching and learning more engaging and individualized. The finding also indicates no significant difference between the male and female teachers with respect to their awareness of AI. This means that the male and female teachers do not differ in their level of awareness of AI. The use of artificial intelligence (AI) in Physics teaching and learning holds the potential to completely transform the way that Physics concept is comprehended, implemented, and shared. Physics teachers both male and female can customize lessons to match the different needs of students by the use of AI.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. There should be workshops and seminars to train in-service Physics teachers on the application of AI in the classroom. Knowledge gained from the workshop will enable teachers to apply AI as a teaching tool in their classes. That will make them master the use of AI tools and familiarize teachers with the concepts, benefits, and practical applications of AI in the classroom.
2. Enugu state government should invest in the necessary technological infrastructure, such as reliable internet access, AI-enabled platforms, and computer labs, to support the effective use of AI tools. This will enable teachers and students to take full advantage of AI technologies for teaching and learning.

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