

STRATEGIES FOR PROMOTING INTEGRATION OF ARTIFICIAL INTELLIGENCE IN THE TEACHING AND LEARNING OF PHYSICS IN SENIOR SECONDARY SCHOOLS IN KOGI EAST

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Abstract

The inclusion of technology in science education curriculum has the potential in transforming pedagogical practices worldwide, prioritizing unprecedented opportunities for interactive and engaging learning experiences. Therefore, this study was designed to assess strategies for promoting integration of Artificial Intelligence (AI) in the teaching and learning of Physics in secondary schools. The study adopted descriptive survey research design. The population of the study comprised all the 460 Physics teachers and 11,370 Physics students in the public secondary schools in Kogi East. The sample size for the study consisted of 46 (10% of 460) Physics teachers and 1,137 (10% of 11,370 students), making a total of 1,183 respondents. The study was guided by one research question. One hypothesis was formulated and tested at 0.05 level of significance. The instrument used for data collection was a structured questionnaire titled “Strategies for Promoting Integrating Artificial Intelligence” (SPIAI), which was developed by the researchers and validated by experts. The internal consistency of SPIAI using Cronbach Alpha method yielded 0.81. Responses were sorted out using a four-point Likert scale of Strongly Agree = 4 points, Agree = 3 points, Disagree = 2 points and Strongly Disagree = 1 point for positive items and reversed for

negatives items. A benchmark of 2.50 was set as the decision for strategy that promotes integration of AI in the teaching and learning of Physics in secondary schools in Kogi State. The responses of both the teachers and students were analyzed using mean and standard deviations to address the research question, while t-test was employed to test the hypothesis at 0.05 level of significance. Findings from the study revealed no significant difference between responses mean scores teachers and students considered as strategies for promoting integration of Artificial Intelligence in the teaching and learning of Physics in secondary schools. Based on the findings of the study, it was recommended among others that secondary school Physics curriculum should be reviewed in order to include Artificial Intelligence into the curriculum contents.

Keywords: Artificial intelligence, teaching, learning, physics, teachers, students

Introduction

Education remains a potent tool by which an individual develops abilities, skills and right attitude in the society. It is the cornerstone of technological advancement and societal development in the modern world. The continuous pursuit of quality education has dominated research discourse and scholarly investigations across all educational levels. The fundamental objective of education is to meet the growing demand for improvement and to produce competent, competitive human resources capable of navigating the complexities of the 21st century. Various disciplines within education system have contributed significantly to shaping contemporary society through pedagogical methods used in classroom worldwide. This implies that good education through the instrumentality of Science, equips an individual to function effectively within his own environment.

Science is a systematic and evidence-based process for understanding the natural world through observation,

experimentation and reasoning. It is a veritable tool needed for shaping the character of modern society and can be considered as the gateway to every nation's exit from mediocrity and underdeveloped (Badmus & Omosewo, 2018). On the other hand, science education is the process of teaching and learning science aiming to develop scientific literacy, foster critical thinking and promote curiosity and inquiry. As reported by Babajide (2015), science education is considered as a field of study that exposes learners to the contents as well as methodology of acquiring scientific knowledge. In addition to this, Kotsis (2024) further states that in science education, Artificial Intelligence (AI) has the potential to bring about significant transformation in the delivery of education. For this purpose Henry (2023) emphasizes the use of AI technologies such as learning machine to enhance learners' learning experience. One of the branches of science that is being studied in secondary schools in Nigeria is Physics. It is a fundamental subject to technology, engineering and mathematics (STEM) education and plays an important role in spearheading technological advancement, promoting national wealth, improving man's health, accelerating industrialization and understanding of the natural world. It is one of the basic science subjects that deals with the study of matter and energy and how they interact (Fasanya & Arivi, 2025). Among the sciences, Physics is considered a fundamental subject that equips learners with systematic thinking and supplies the theories of how the things mankind relies on work. The subject provides students with analytical, problem solving and quantitative skills that are relevant for other sciences (Ali, et al., 2024).

In this fast growing world, Artificial Intelligence (AI) remains one of the technological developments in recent time which has been adding value to mankind in various ways, such as education, research, communication among others. As the world is experiencing a notable change due to the societal demands and aspirations, studies revealed that AI, which is transforming different phases of human endeavour, including education has the

capability to change Physics education through interactive simulation and personalize learning experiences (Anaso & Anaso, 2025; Yang et al., 2021). It has been observed that AI technologies are becoming integral to various sectors such as healthcare, manufacturing, transportation and notably, security. With automation, machine learning and AI-driven systems replacing and enhancing traditional processes, the demand for professional proficient in these technologies is rapidly increasing (Fasanya et al., 2025). This transformation necessitates an urgent shift in educational landscape, particularly, in Science, Technology, Engineering and Mathematics (STEM) education to prepare students for better academic attainment.

According to Ayala-Passimo (2023), Artificial Intelligence is transforming the world including Physics education, which can be achieved through improving teaching and learning outcomes. Artificial Intelligence encompasses a range of techniques and applications that enables machine to imitate human intelligence, learn from data and make decisions based on patterns and insights of man (Mahligawati et al., 2023). AI is a study area in computer science whose concerns are aimed at solving different cognitive problems commonly associated with the human intelligence such as learning, problem-solving, as well as pattern recognition. As reported by Faisal et al. (2021), AI has been designed and developed to assist decision making processes through analysis of data and prediction of the best designated outcome variable. In view of this Ayeshung (2025) posits that AI has come a long way in adding values to man activities and has faster thinking capacity, which has touched man's life in many areas such agriculture, transportation, communication, medicine, research as well as other services that make man living comfortably.

However, despite the potential of AI, its adoption in Nigeria secondary schools experiences several challenges, including limited infrastructure, lack of technical expertise, concern about data privacy and lack of facilities (Sunday-Cookey & Nwankwo,

2025). In furtherance to this, Nwafor and Ololube (2024) state that lack of and poor condition of these facilities tend to lower teachers' morale and reduce their level of commitment. Apart from this, Zudonu et al. (2024) reported that many schools in Nigeria are still struggling with basic digital integration of AI into the curriculum, making it difficult to implement advanced AI solution. All these factors can contribute to the problem of integrating AI into areas such as Biology, Chemistry and Physics curricula. Indeed, improving the quality of Physics education in Nigeria largely depends on the integration of ICT and more recently, AI technologies, which by considering areas for development render assistance to teachers and students and enhance teaching and learning (Edu & Uwelegbewe, 2025). Integrating AI in education may attract increasing interest and performance of students in Physics. Therefore, this study sought to address the strategies for promoting integration of Artificial Intelligence in the teaching and learning of Physics in senior secondary schools.

According to Kumi-Manu and Philip (2026) the adoption of Artificial Intelligence (AI) in the educational circle has demonstrated a clear breakthrough in contemporary pedagogy that has completely changed the ways of delivery instructions, receiving them by learners and measuring the productivity in diverse educational disciplines. In the area of science education, especially in Physics, AI poses great opportunities in terms of personalizing the learning process, replicating mechanisms of complex Physics processes, enriching hands-on learning through virtual models and aligning the approach to teaching to diverse learners. As stated by Aina et al. (2023) AI encompasses a system which is technologically advanced and is capable of exhibiting cognitive abilities of a human being to complete task that are intelligence-based. In same vein, Cooper (2023) also describes AI as an imitation of human thinking process, which enables machine to process information and act in various learning settings. In the study of Anazo and Anazo (2025), it was stated that AI has capability for transforming the teaching of science subject,

especially Physics through the integration of advanced technologies such as Machine Learning (ML), Deep Learning (DL) and Natural Language Processing (NLP). They further indicated that these tools can enrich the educational experience by enabling predictive modelling, interactive simulations, automated assessments and personalized learning pathway. As educational reforms are being sought in Nigeria, especially in Kogi State, AI is becoming an important topic of interest in science education.

Similarly, Zudonu et al. (2024) reported that the introduction of AI into the educational sector has potential to revolutionize important areas such as teaching and learning process, granting access to universal quality education to all, reducing the workload of the teacher, spurring the students to access unlimited knowledge from the comfort of their homes, among others. Furthermore, in educational practices, in particular, the teaching methods used and the process of learning can be enhanced by AI. It is obvious that the academic institutions across the globe is are adopting AI in order to generate pedagogical, school leadership and security system innovation (Xu, 2024). According to Zhao and Watterson (2021) during crisis like the pandemic and material shortage, some educators are swapping in-person teaching objects with their digital facsimiles such as animated videos and interactive simulations, especially in Physics. The same strategy would be useful in Kogi State since it requires innovative practices to tackle deficiencies and promote equal provision of science education. However, aligning it with idea of international standards, it is not enough to have an education that is not resistant to AI tools, teachers should be able to explain competently how to use such tools in their teaching to provide modern and more student-centred approach. Teachers are not just required to choose appropriate AI tools but also to ensure that these tools complement learning objectives, professional maintain ethical practices and struggle against the themes of misinformation and information security (Kotsis, 2024).

Integration of AI in secondary school, especially in Physics education curriculum will provide various opportunities such as creating a better professional environment for teachers to work more on students with learning difficulties, mapping each student's learning plans and trajectories, among others (Sunday-Cookey & Nwankwo, 2025). Likewise, Verawati and Nisrina (2024) posit that AI provides alternative access to learning for students from diverse academic background, particularly, in Physics thereby improving their engagement, accessibility and understanding the abstract Physics concepts. These opportunities have started unfolding in developed countries such as China that has 730 million internet users and through her Ministry of Education emphasizes allocation of at least 8% of her annual budget to the digitalization of education. In recent years, America has made several initiatives in pushing the introduction of computers in education at large scale. More so, Liulishuo is another country that teaches English to 600,000 students by a single teacher. These and other opportunities of AI form the purpose for examine the strategies for promoting the integration of AI in the teaching and learning of Physics in secondary schools in Kogi East Educational Zone, Nigeria.

Statement of the Problem

The interest and academic performance of students in is a major concern for science educators. Considering Physics as fundamental to technological development of any nation. Research reports have pointed at low interest and performance of students in Physics because of poor instructional strategies adopted by the Physics teachers. Due to this, there is need integrate AI into the teaching and learning of science subjects, particularly Physics.in order to improve their interest and academic performance in the subject. Therefore, this study was designed to assess strategies for promoting integration of Artificial Intelligence (AI) in the teaching and learning of Physics in secondary schools in Kogi East, Nigeria. The contributions of Physics in the development of nation cannot be over-emphasized. However, despite the important of the subject, literature reviewed has shown that the various teaching methods

adopted by the Physics teacher to teach the subject have not been improving students' interest and their academic performance in the subject, particularly in Kogi East Educational Zone. The implication of this is that many students may not be enlisted in Physics related courses such as medicine, pharmacy, engineering, microbiology, biochemistry, geology, among others. This means that there will be shortage of doctors, engineers, geologists, pharmacist – such a situation may not be good enough for a developing country like Nigeria. Thus this study sought to address the inclusion of AI into the teaching and learning of Physics in senior secondary schools in Kogi East Educational Zone.

Research Question

The following research question was generated to guide the study. What are the mean responses that teachers and students consider as strategies for promoting integration of Artificial Intelligence in the teaching and learning of Physics in secondary schools in Kogi East?

Hypothesis

There is no statistical significant difference between the mean responses of teachers and students on strategies that can promote integration of Artificial Intelligence in teaching and learning Physics in secondary schools in Kogi East

Methodology

The study employed a descriptive survey research design. The design was considered appropriate because it sought to elicit Physics teachers and students opinion on strategies that can promote the integration of Artificial Intelligence in the teaching and learning of Physics in secondary schools. The area of the study was Kogi East. The population of the study comprised all the 460 Physics teachers and 11,370 Physics students in public secondary schools across the Kogi East Senatorial District of the State (Ministry of Education, Science and Technology, Kogi State, Nigeria 2023/2024). The sample size for the study, through simple

random sampling technique consisted of 10% of the population (46 teachers and 1,137 students) making a total of 1,183 respondents. One research question guided the study. One hypothesis was formulated and tested at 0.05 level of significance. The instrument used for data collection was a structured questionnaire titled “Strategies for Promoting Integrating Artificial Intelligence” (SPIAI), which was developed by the researchers after reviewing relevant literatures and was face validated by experts. The internal consistency of SPIAI using Cronbach Alpha method yielded 0.81. Responses were recorded using a four-point Likert scale of Strongly Agree = 4 points, Agree = 3 points, Disagree = 2 points and Strongly Disagree = 1 point for positive items and reversed for negatives items. A benchmark of 2.50 was set as the decision for strategy that promote integration of AI in the teaching and learning of Physics in secondary schools in Kogi East. The responses of both the teachers and students were analyzed using mean and standard deviations to address the research question, while independent t-test was employed to test the hypothesis at 0.05 level of significance.

Results

Research Question: What are the mean responses that teachers and students consider as strategies for promoting integration of Artificial Intelligence in teaching and learning Physics in secondary schools in Kogi East?

The data in Table 1 revealed the responses of teachers and students on the strategies that can promote the integration of Artificial Intelligence in the teaching and learning of Physics in secondary schools in Kogi East. The data showed that all the mean scores of both teachers and students were above the decision level of 2.50. This indicates that the respondents agreed that these strategies can promote the integration of Artificial Intelligence into the teaching and learning of Physics in secondary schools.

Table 1: Mean and Standard Deviations of the responses of Teachers and Students on Strategies that can Promote Integration of Artificial Intelligence

S/N	Items	Teacher		Decision	Students		Decision
		Mean	Std		Mean	Std	
1	Physics teachers' knowledge of AI is sufficient for effective use in teaching Physics	2.74	0.76	Agreed	2.73	0.77	Agreed
2	Provision of technical expertise widens the teacher and student skills gap	3.04	0.68	Agreed	3.02	0.66	Agreed
3	Equitable use of AI urban and rural schools will provide balance community development	2.63	0.78	Agreed	2.68	0.79	Agreed
4	Creation of free periods and extra time for lessons on AI knowledge and practices	2.81	0.63	Agreed	2.78	0.65	Agreed
5	Regular training and retraining of Physics teachers on the integration of AI in teaching and learning Physics	3.14	.59	Agreed	3.11	0.61	Agreed

S/N	Items	<u>Teacher</u>		Decision	<u>Students</u>		Decision
		Mean	Std		Mean	Std	
6	Secondary school Physics time table should give room for integration of AI	3.21	0.51	Agreed	3.18	0.54	Agreed
7	Active involvement of indigenous people to give necessary technical support of integration of AI	2.55	0.80	Agreed	2.61	0.74	Agreed
8	Partnership with industries in order to motivate teachers and students involvement in the integration of AI	3.33	0.42	Agreed	3.22	0.44	Agreed
9	Regular and effective monitoring of integration of AI into teaching and learning Physics by school administrators	2.98	0.66	Agreed	2.89	0.68	Agreed
10	Adequate funding of schools by the government for procurement of AI facilities	3.04	0.55	Agreed	2.99	0.61	Agreed
11	Enlightening the general public on the benefits of integrating AI into secondary school system	3.27	0.49	Agreed	3.09	0.53	Agreed
12	Transparency and accountability in the use of AI that help educational administrators to make informed decisions	2.56	0.81	Agreed	2.71	0.83	Agreed

S/N	Items	<u>Teacher</u>		Decision	<u>Students</u>		Decision
		Mean	Std		Mean	Std	
13	Regular power supply both in urban and rural schools.	3.09	0.49	Agreed	3.12	0.46	Agreed
14	Removal of potential bias in AI decision making	2.99	0.74	Agreed	2.88	0.76	Agreed
15	Provision of adequate AI facilities as well as motivation of teachers and students at various levels	3.26	0.54	Agreed	3.08	0.58	Agreed
	Aggregate Values	2.97	0.63	Agreed	2.94	0.64	Agreed

The bold values indicate that both teachers and students have agreed that the strategies listed above can promote AI integration into the secondary school Physics curriculum contents.

Testing of Hypothesis

There is no statistical significant difference between the mean responses of teachers and students on strategies that can promote integration of Artificial Intelligence in the teaching and learning of Physics secondary schools in Kogi East.

The data in Table 2 revealed the t-test analysis of the difference between the mean responses of teachers and students on strategies that can promote AI integration in teaching and learning of Physics.

Table 2: Analysis of t-test showing the Difference between the Mean Responses of Teachers and Students

Categories	N	Mean	SD	df	P-Value	t _{cal}	t _{cri}	Decision
Teachers	46	2.97	0.63	1181	0.05	0.316	1.96	Accepted
Students	1137	2.94	0.64					

The results presented in Table 2 indicated that t_{cal} of 0.316 was obtained. Since this value is lower than $t_{critical}$ (1.96), the null hypothesis was accepted. This implies that there was no statistical significant between the mean responses of teachers and students on strategies that can promote the integration of AI in the teaching and learning Physics in secondary schools.

Discussion of Findings

The finding with respect to the lone research question revealed that integration of Artificial Intelligence into Physics curriculum contents, adequate training of Physics teachers, adequate funding, constant power supply, provision of AI facilities are strategies that can promote integration of AI in teaching and learning of Physics. The respondents also agreed that enlightening the general public on the prospects of integrating AI, the involvement of industries in supporting the integration of AI, transparency and accountability in the use of AI can promote the integration of AI in teaching and learning Physics in secondary schools in Kogi East. These results are in agreement with Sunday-Cookey and Nwankwo (2025) who recommended that for effective integration of AI to provide teachers with professional development opportunities, AI systems should be designed with transparency and accountability in mind.

The finding with respect to the testing of the lone hypothesis indicated no significant difference between the mean responses of teachers and students on strategies that can promote integration of AI in teaching and learning of Physics. The results showed that both the teachers and students considered that the aforementioned strategies can promote integration of AI in the Physics curriculum. The results is in consonant with Kumi-Manu and Philip (2026) who reported that the tenets of the Technology Acceptance Model (TAM) that postulates the choices of educators to use new technologies are more motivated by their thoughts, utility and convenience.

Conclusions

The adoption of AI is very significant in teaching and learning of

activity-based subject such as Physics. The study has identified strategies for promoting integration of AI in the teaching and learning of Physics in secondary schools in Kogi East. Furthermore, the study has confirmed that there was no statistical significant difference between the Physics teachers and students' opinion on the strategies that can promote the integration of AI into the teaching and learning of Physics in secondary schools.

Recommendations

To improve on the teaching and learning of Physics in Kogi East, the following recommendations were provided.

1. There should be periodical review of Physics curriculum in order to include AI in the curriculum content in Kogi East.
2. Industries should be involved in promoting the integration of AI by encouraging and supporting Physics teachers and students.
3. Training and re-training of Physics teachers in the use of new technologies for teaching Physics in Kogi East.
4. Government with relevant stakeholders should provide the needed AI facilities that will enable Physics teachers implement AI curriculum in lesson planning and assessments more effectively in Kogi East.

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