EFFECTS OF AI INSTRUCTIONAL PLATFORM ON STUDENTS' ACADEMIC PERFORMANCE IN PHYSICS IN EKITI STATE SECONDARY SCHOOLS

BY

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Abstract

The study investigated the effects of AI Instructional platform on students' academic performance in Physics in Ekiti State Secondary Schools. A quasi-experimental research design was employed for the study. The population comprised 11,603 Senior Secondary School two students from 202 public secondary schools in Ekiti State, Nigeria. A sample of 100 SS2 Physics students were selected through multistage sampling procedure. Data were collected using the Physics Performance Test (PPT). The instrument was validated by experts in Science Education, Ekiti State University, Ado Ekiti and yielded a reliability co-efficient of 0.78. The study lasted eight weeks, data obtained were analyzed using descriptive and inferential statistics. Mean and standard deviation were used to answer research question while all hypotheses were tested using t-test at 0.05 level of significance. Findings of the study revealed that students taught with the AI instructional platform significantly performed better than those taught with the conventional method in Physics. It was recommended that Physics teachers should adopt AI instructional platforms such as Khan Academy to improve teaching and academic performance in Physics. Physics teachers should receive training on the use of AI and digital learning platform like Khan Academy to maximize their effectiveness and ensure successful implementation in classrooms. Also, Curriculum planners should consider integrating AI learning into the Physics curriculum to complement traditional teaching methods and encourage interactive, personalized learning experiences.

Keywords: Artificial Intelligence, physics, academic performance, AI Instructional platform, secondary school students

Introduction

In the constantly evolving landscape of education globally, technology played a pivotal role in transforming traditional teaching methods and enhancing students' learning outcomes. One of the most groundbreaking advancements is the integration of Artificial Intelligence (AI) into the field of education. Education is an avenue of training and learning especially in schools. The ultimate purpose of education is to empower an individual to excel in a chosen field of career, and to be able to positively impact his environment. Education is the process of facilitating learning, acquiring knowledge, skills, values, beliefs, and habits through teaching, training, research or self-study. It is a structured process that helps individuals develop intellectually, socially, and emotionally to function effectively in the society. Nigeria as a nation recognizes that education is a national activity which involves an orderly, deliberate and sustained effort to transmit or develop knowledge, concepts, skills and attitude or habits, hence her determination to provide lifelong education for her citizens (Badmos, Agbeti & Umeh, 2016, Ayeni, 2022).

Science is a systematic knowledge of the environment. It provides a body of knowledge for addressing various forms of human, material and environmental problems. Science can be viewed as composed of two major complementary modes, viz: accumulation of knowledge through exploration and discovery efforts about the natural world, and the use of such knowledge for human and material

development. Science and technology allow students to observe, collect evidence and draw inferences to arrive at solutions to problems. This helps students learn new content and solidify their understanding of previously learned concepts, ideas, and theories. As a result of science value and relevance to human civilization, it seems to be receiving more attention in the education system. People from all over the world are living in an age of science and technology, which has led to breakthroughs like gene therapy for blood cancer treatment and the use of CCTV cameras for security. In our current globe, all human activities and style of life are highly impacted by science since nature normally talks science every day (Omotayo, 2016).

Nigeria is a developing nation with an increasing demand for science-based skilled man-power. The attainment of this goal could be fostered through the acquisition and application of the enabling skills inherent in science subjects including Biology, Chemistry and Physics, beginning from the Secondary School level. The Science which aims at understanding the physical world we live in is called Physics (Adolphus, 2020).

Physics is an aspect of science that deals with physical phenomena of our world (Adedayo, 2016). Its role in the advancement of national growth in science and technology is germane. Physics as a field of study is critical in understanding the occurrences in the universe. This is because Physics is a physical science that deals with the world and everything that happens around us, especially as related to force, energy and motion (Adedayo & Akinbode, 2025).

Academic performance refers to students' achievement and success in the educational endeavours. It is typically measured by assessing students' grades, test scores, and overall academic accomplishments. It serves as an indicator of students' mastery of the subject, his ability to apply knowledge, and level of engagement in the studies. Teachers, parents and educational institutions use academic performance to identify areas of strengths and weaknesses, tailor instructional support and track students' progress over time.

Much as the role of Physics in the nation's technological development cannot jettisoned, it is disappointing to note that the academic performance of students in Physics, especially in external examinations, has been fluctuating over the years in Nigeria. Stakeholders such as teachers, parents, school administrators and policy makers in Nigeria's education system are very concerned about the inconsistency in the academic performance in Physics among students. Some of the issues found to be responsible for this inconsistencies have been traced to the abstract nature of Physics concepts, students attitude towards Physics, gender difference, school location, inappropriate teaching strategies and methods, inadequate facilities, lack of instructional materials, teachers professionalism, among others (Ayeni, Omotayo and Adedayo, 2016).

One major factor found to be responsible for the fluctuation in academic performance of students in Physics is the teaching methods employed by the teachers in the classroom (Adedayo, 2022; Adedayo & Ajayi, 2022). Over the years, the traditional methods of teaching have been the most used teaching methods in the teaching of Physics. These methods of teaching Physics may not always effectively convey the complex ideas in a way that resonates with students. Physics requires students to understand and apply complex mathematical equations, scientific principles, and theories, which can be challenging to grasp through traditional teaching methods alone. Currently, we live in a scientifically and technologically advanced society where students face difficulties and problems in subjects like Physics, mathematics, and other physical science related subjects. Therefore, there is a need for the introduction of more engaging teaching methods into the teaching of Physics such as, the Online Instruction, the use of AI instructional platforms, Computer Assisted Instruction, video based teaching, etc. The use of any of these methods will assist teachers in delivering Physics concepts in a more interesting way that will enhance their engagement and better understanding in Physics concepts. This is where AI instructional platform comes into play offering innovative solutions to make Physics more accessible and engaging for students towards enhancing performance in the subject.

AI, which is an acronym for Artificial Intelligence, is a field of study that explores how to make computers perform tasks that would typically require human intelligence, such as virtual perception, speech recognition, decision-making and language

understanding (Crawford, 2021). It is the use of intelligent machines, especially computers, to simulate human intelligence in machines that are programmed to think and mimic human actions. It is the branch of computer science, which makes the computers to mimic human behaviour to assist humans for better performance. AI Replicates human intelligence, solves knowledge-intensive tasks, builds machines, which can perform tasks that require human intelligence, creating some systems which can learn by itself. Machine learning and deep learning are two subsets of AI which are used to solve problems through high performance algorithms and multilayer neural networks, respectively.

The use of AI has become an inseparable part of human life. Various aspects of human life have been affected by the existence of AI developments ranging from individuals to government agencies and has influenced all spheres of human endeavours, education inclusive. The integration of AI technologies in education has advanced the transition of educational system from the ancient analog era to the digital world. Furthermore, with the recent developments in AI technologies, it is apparent that AI will continue to influence man's daily activity. In classroom teaching, AI has the potential to revolutionize the way students engage with educational contents, receive feedback, and ultimately improve their academic performances. The incorporation of AI in education has opened new possibilities for personalized and adaptive learning experiences for students.

AI systems can tailor instructional content to individual student needs, preferences, and learning styles. Platforms such as Khan Academy, Google Classroom, Coursera, penseum, Kira Learning, Labster among others are designed to meet individual student needs, optimize instruction, and improve academic performance. Khan Academy is an already existing online adaptive learning platform that uses a combination of human-created content and AI-powered tools to provide personalized learning experiences. Its primary AI feature is its "Khanmigo" tool, which provides personalized feedback and support to both teachers and students as they work through exercises, essentially acting as an AI tutor that can adapt to each student's learning pace and needs, offering hints, explanations, video contents and questions based on their progress and understanding. The video contents on the platform can be downloaded and watch on YouTube channel. This allows for a more customized learning experience compared to traditional educational contents. It makes use of AI technologies such as machine learning, deep learning, natural language processing, and computer vision. It provides several benefits such as personalized learning experiences, improves student's engagement, and enhances students' academic performance.

Statement of the Problem

Physics is one of the core science subjects in secondary school and serves as a foundation for many science and engineering-related disciplines. It plays a fundamental role in determining the scientific and technological capabilities of a nation. Physics remains a foundational subject in sciences, critical to technological advancement and innovations. However, despite its importance, the academic performance of secondary school students in physics over the years continued to fluctuate, as evidenced by the inconsistency in external examinations results such as West African Senior School Certificate Examination (WASCE). These fluctuations have raised serious concerns about the effectiveness of the conventional teaching methods and the overall learning experience of students in Physics. A lot of research attribute these performance challenges to various factors such as limited students' engagement, abstract content delivery, lack of real-world applications, inadequate instructional resources, students' attitude towards Physics, among others.

The conventional chalk-and-talk approach seems to be insufficient in addressing the diverse learning needs of today's students, many of whom thrive in interactive, technology-driven environments. There is the need therefore to attempt considering an instructional strategy that is technology based. In this regard, the upcoming Artificial Intelligence (AI) assisted instructional platforms could come to the mind for consideration. Artificial Intelligence (AI)-assisted instructional platforms have emerged as innovative platforms capable of transforming the teaching and learning process. These platforms offer personalized learning experiences, immediate feedback, adaptive learning and interactive simulations

that can make complex physics concepts more accessible and engaging.

Students today have become so vast in the use of technology to the extent that they search the internet for virtually every information they need. They no longer depend on the conventional method of instruction confined to the four walls of the classroom and explanations from their teachers alone. They could do their assignments using AI tools and platforms like Chat GPT, Meta AI, Perplexity AI, Khan Academy, etc. They go as far as getting more clarifications and detailed explanations on complex concept in physics which they may not understand in the class. Seeing how students are so interested in the use of AI platforms, tools, and techniques, the researcher thought it wise to go into this study to investigate if perhaps these AI tools and platforms that students are so interested in, could be annexed to influence their academic performance in Physics, especially the Khan Academy. This study therefore, investigated the effects of AI Instructional platforms such as Khan Academy on students' academic performance in physics.

Purpose of the Study

The main purpose of the study was to investigate the effects of AI Instructional Platform on Senior Secondary School Physics Students' academic performance in Ekiti State, Nigeria. Specifically, the study:

i. investigated the effects of AI instructional platform on students' academic performance in Physics.

Research Question

One research question was raised to guide the study:

1. Would the use of AI- instructional Platform influence students' academic performance In Physics?

Research Hypotheses

The following null hypotheses were formulated and tested for the study:

1. There is no significant difference in the academic performance of students in experimental and control group before treatment.
2. There is no significant difference in the academic performance of students in experimental and control group after treatment.

Methodology

The study adopted a quasi-experimental of pre-test post-test control group design. The population of the study comprised all Senior Secondary two Physics Students numbering 11,603 across the sixteen Local Government Areas in Ekiti State, Nigeria. The sample for the study was 100 Senior Secondary two (SS II) students selected from four Schools in Ekiti State. The sample was selected through multistage sampling procedure. At the first stage, one senatorial district was selected out of the three senatorial districts in Ekiti State using simple random sampling technique. The second stage was the selection of two Local Government Areas (LGAs) from the selected senatorial district using, simple random sampling technique. The third stage was the selection of two schools from each of the two Local Government Areas, using purposive sampling technique as a result of functional facilities needed. The study made use of one instrument tagged "Physics Performance Test" (PPT) designed by the researcher. The Physics Performance Test (PPT) contained items drawn from SS II Physics curriculum. The PPT consisted of two sections, Section A elicited information on the bio data of the respondents such as name of school, gender and local government. While section B contained 20 multiple choice items with four options (A-D). Items of the pre-test were re-arranged and administered as post-test to avoid hallow effect.

The instrument was subjected to face and content validity by expects in Science Education, Tests, Measurement and Evaluation in the Faculty of Education, Ekiti State University, Ado-Ekiti. The reliability of the instrument was determined through test re-test reliability method. The results obtained were subjected to Pearson's Product Moment Correlation analysis which yielded a reliability co-efficient of 0.78 which adjudged the instrument to be reliable. The data collected through the PPT were analyzed using descriptive and inferential statistics. Mean and standard deviation were used to answer the research question. While all the hypotheses were tested using t-test at 0.05 level of significance.

Results

Research Questions 1: Would the use of AI Instructional Platform influence students' academic performance in Physics?

In answering this question, the physics students were exposed to AI-assisted instructional platform before treatment and data collected was exposed to descriptive statistics of mean and standard deviation. The result was presented in Table 1

Table 1: Mean and Standard Deviation of students' performance in Physics before and after exposure to AI Instructional platform and Conventional Method

Group	*N*	*Before*		*After*		*Mean Difference*
		Mean	*SD*	*Mean*	*SD*	
AI Instructional Platform	54	41.28	6.42	74.63	7.85	33.35
Conventional Method	46	40.87	6.11	58.94	8.27	18.07

The results in table 1showed that the experimental group improved from a pre-test mean score of 41.28 (SD = 6.42) to a post-test mean score of 74.63 (SD = 7.85), resulting in a mean difference of 33.35. The control group also moved from a pre-test mean score of 40.87 (SD = 6.11) to a post-test mean score of 58.94 (SD = 8.27), with a mean difference of 18.07. Although both groups improved after treatment, the improvement recorded by the experimental group was markedly higher. This shows that AI Instructional platform positively influenced students' academic performance in Physics.

Testing of Hypotheses

Hypothesis 1: There is no significant difference in the academic performance of students in experimental and control group before treatment.

To test Hypothesis 1, pre-test mean scores of students in experimental and those in the control group were computed and compared for statistical significance using t-test at 0.05 level of significance. The result is presented in Table 2.

Table 2: t-test analysis of the academic performance of students in experimental and control groups before treatment

Group	*N*	*Mean*	*SD*	*df*	*t*	*p*
Experimental	54	41.28	6.42	98	0.31	0.76
Control	46	40.87	6.11			

p>0.05

Table 2 showed the t value (98) = 0.31, p = 0.76 > 0.05, indicating no significant difference between the groups. Thus, the null hypothesis was not rejected. This confirms that both groups started with comparable performance levels, i.e. homogeneous. By implication, any post-test differences can be attributed to the treatment.

Hypothesis 2: There is no significant difference in the academic performance of students in experimental and control group after treatment.

To test Hypothesis 3, post-test mean scores of students in experimental and control groups were computed and compared for statistical significance using t-test at 0.05 level of significance. The result is presented in Table 3.

Table 3: t-test analysis of the academic performance of students in experimental and control group after treatment

Group	*N*	*Mean*	*SD*	*df*	*t*	*p*
Experimental	54	74.63	7.85	98	9.97	0.000
Control	46	58.94	8.27			

p<0.05

Table 3 presented the **t value (98) = 9.97 and p < 0.05,** indicating a significant difference between the groups, with the experimental group performing better, having a higher mean. This revealed that the AI Instructional platform had a positive and significant effect on students' academic performance in Physics.

Discussion

The study found that students taught with the AI instructional platform performed better in Physics than those taught using conventional methods. This aligns with the submission of Okoye, et al. (2024), that there was an improvement in students' performance through technology-enhanced learning. This might be the reason why Ukoh and Nicholas (2022), concluded that the teachers in Ibadan North Local Government Area supported the adoption of AI in Physics teaching. A likely explanation is that AI platforms offer interactive engagement and addresses individual learning gaps in Physics than the conventional methods. In contrast, conventional methods are often teacher-centered and less responsive to individual needs.

The finding of the study also showed that there was no significant difference in the academic performance of experimental and control groups before treatment. This baseline equivalence is crucial for attributing any post-treatment differences to the intervention itself rather than pre-existing disparities. This is in line with the observations of Oladipo and Adeyemi (2020), establishing similar starting points ensures that the effects of instructional innovations, such as AI-assisted platforms, can be evaluated more reliably. A plausible explanation is that students across both groups shared similar performance in Physics contents, teacher quality, and school resources, which minimized initial differences in academic performance. This is consonant with the finding of Chukwuma and Okechukwu (2021), who reported that pre-test equivalence between groups is common in well-designed experimental studies in Nigerian secondary schools and forms a sound basis for subsequent comparison. This baseline finding showed the methodological rigor of the study, ensuring that any observed improvements in performance following the treatment can be confidently linked to the AI instructional platform rather than other confounding factors.

The study found a significant difference in students' academic performance after the treatment,the experimental group was significantly higher than that of the control group. This shows that AI instructional platform had a positive impact on students' academic performance in Physics. This finding is in consonance with the submission of Okoye, et al. (2024), who reported that technology-enhanced learning significantly improved the academic performance of students in Physics in Nigerian secondary schools. Similarly, Eze and Iroegbu (2021) found that integrating digital instructional tools in science teaching enhanced students' understanding and problem-solving abilities. A plausible explanation for this improvement is that AI platforms provide interactive, personalized learning experiences and immediate feedback, which help students identify and address gaps in their understanding. Conventional teaching methods, by contrast, are often teacher-centered and may not address individual learning needs effectively, leading to lower performance outcomes. Moreover, studies by Adebayo and Bello (2023) have shown that students exposed to interactive and adaptive learning environments demonstrate higher retention and application of complex concepts compared to peers in traditional classrooms. However, Fwangle, et al. (2025), cautioned that the effectiveness of AI-based instruction can be moderated by factors such as teacher competence and resource availability, suggesting that successful implementation requires careful planning and support. This finding demonstrates the potential of AI instruction to enhance academic performance in Physics when properly integrated into teaching practices.

Recommendations

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

1. Schools and educational authorities should adopt AI instructional platforms like Khan Academy to enhance students' academic performance in Physics.
2. Physics teachers should receive training on the use of AI and digital learning platform like Khan Academy to maximize their effectiveness and ensure successful implementation in classrooms.
3. Government and school management should provide functional computer facilities and reliable internet access.

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