INTERNATIONAL JOURNAL OF CONTEMPORARY ISSUES IN INTEGRATED SCIENCE EDUCATION (IJCIISE)

ISSN: 3043-6397

IJCIISE

IJCIISE, Vol. 1, No. 1, 2025

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INTERNATIONAL JOURNAL OF CONTEMPORARY ISSUES IN INTEGRATED SCIENCE EDUCATION (IJCIISE)

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EDITORIAL

Dear Readers,

We are excited to announce the launch of International Journal of Contemporary

Issues in Integrated Science Education (IJCIISE). This Association Integrated Science Educators' Association of Nigeria (ISEAN) play a vital role in promoting scientific advancement, supporting science education, informing science policy, recognizing science excellence and fostering community engagement. The desire to float this journal was borne out of the passion to organize a yearly conference of Integrated Science by the Integrated Science Educators' Association of Nigeria, of which selected scholarly articles will be published after a thorough review. The journal dedicated to advancing knowledge and fostering dialogue within. Our mission is to publish high-quality research, innovative ideas, and critical analyses that contribute to the understanding and development of Integrated Science. At IJCIISE, we believe in the power of interdisciplinary collaboration and inclusivity. We welcome contributions from scholars, practitioners, and thought leaders worldwide, providing a space for diverse perspectives and groundbreaking work. As we embark on this journey, we invite you to submit your research, engage with our content, and join us in creating a vibrant academic community. Together, we can push the boundaries of knowledge and inspire future generations. Thank you for your support as we launch this exciting new endeavour.

This edition moves around issues that border on **''Enhancing Quality Assurance in Integrated Science in Nigeria.''** It is believed that diverse contributions from scholars and researchers expressed in this edition will provoke the understanding of issues that could foster education for societal transformations on a global scale We look forward to your contributions!

For further information on future conference activities, visit
http://ijciise.org/index.php/ijciise

Warm regards, Professor O. S. Agboola
President, Integrated Science Educators' Association of Nigeria (ISEAN)

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AI-TRANSFORMATIVE TOOLS IN TACKLING CHALLENGES IN TEACHING OF PHYSICS IN TERTIARY INSTITUTIONS

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Abstract
The paper explores AI-Transformative tools in tackling challenges in teaching and learning physics in tertiary institutions. Adopting a typology design and conceptual approach, the study examines the available literature on AI-driven tools and their adoption in physics education. Artificial Intelligence can provide personalized learning experiences, instant feedback, and adaptive assessments, addressing traditional teaching methods' limitations. The study highlights three key benefits of AI in physics education: enhanced student engagement, increased accuracy, and improved teacher support. The paper identifies various AI-driven tools, such as Robot motor, drone, High Performance Computing (HPC), ChatGPT, Chatbot Einstein, and physics learning tutor, that can help address teaching physics challenges. However, it also acknowledges AI implementation challenges like validity and reliability concerns, technology dependence, data security issues, and biased discrimination. The study emphasizes the need for teachers to effectively integrate AI tools with traditional teaching methods and suggests that governments and institutions should provide necessary equipment and support for this technological advancement. Overall, the study concludes that AI, combined with basic computer tools, can significantly improve learning outcomes in physics education if carefully implemented and monitored to ensure effectiveness and fairness.
Keywords: AI-Transformative tools, Tackling challenges, Teaching-learning of Physics, Academic performance.

Introduction

The constantly changing world of education, technology has become a powerful catalyst for transformation revolutionizing the way we learn and teach. Among the various disciplines, physics stands out as a fundamental subject that

underpins our understanding of the natural world. As we continue to push the boundaries of human knowledge, Incorporating Artificial Intelligence (AI) into physics education holds the promise of opening up new avenues for innovation and discovery. This study seeks to explore the confluence of physics and AI, examining the opportunities and challenges that arise when these two dynamic fields intersect. By harnessing the power of AI, we can create personalized, adaptive, and immersive learning experiences that empower students to grasp the complexities of physics and unleash their full potential. Education is a pivotal force in national progress, serving as a catalyst for advancements across diverse domains. Physics, a cornerstone of science and technology, holds a paramount role in this educational landscape. Artificial Intelligence (AI) represents the ability of machines to perform tasks that typically require human cognitive abilities, such as solving problems, learning new things, and making decisions, and perception. Emulating human cognition, AI systems acquire knowledge from experience, identify patterns, make data-informed choices, and address complex challenges. Comprising machine learning, natural language processing, robotics, computer vision, and expert systems, AI finds applications in various sectors, from automated support and medical diagnostics to facial recognition and autonomous vehicles. Integrating Artificial intelligence into physics education presents an opportunity to deliver more personalized, adaptive, and comprehensive learning experiences for both students and educators a more personalized, adaptive and comprehensive learning experience. A primary potential of Artificial Intelligence in physics education and learning is its capability to deliver personalized and enduring learning experiences. By leveraging intelligent algorithms, Artificial Intelligence systems can analyze information to comprehend individual student learning patterns (Abbas, Faisal, Ghazi, & Gul, 2023).

The ability of AI to offer a personalized and adaptive learning experience is one of the major potentials of AI in physics education (Abbas, Faisal, Ghazi & Gul, 2023). Artificial Intelligence (AI) systems are able to adjust the content, teaching strategies, and level of difficulty to each student's needs and comprehension by utilizing clever algorithms to assess individual student data and detect distinct learning patterns. This can aid pupils in comprehending physics ideas more fully. The capabilities of AI can be compared to those of supercomputers, which possess exceptional processing power, adaptive behavior, and cognitive functions similar to human intelligence.

Supercomputers are often synonymous with Artificial Intelligence. These machines possess immense computational power, coupled with adaptive capabilities like sensors, and exhibit cognitive functions that mirror human thought processes. These attributes significantly enhance human-supercomputer interaction (Limna, Alshammari & Farhan, 2022). Numerous studies have demonstrated the capabilities of Artificial Intelligence. For instance, intelligent building technology can regulate temperature, air quality, and even music based on occupant preferences (Allam, Jones, & AbouRizk, 2022)."The evolution of online and web-based education has transformed the way students access and interact with educational materials. From

simply downloading and studying materials, intelligent and adaptive web-based systems can learn the behavior of teachers and learners, adapting to enhance the learning experience (Xia, Huang, & Yu, 2022). Artificial intelligence has been integrated into education, encompassing administration, teaching, and learning. AI provides instant and accurate feedback to students, detecting understanding errors and offering real-time explanations and suggestions for improvement (Yu, & Guo, 2023). Personalized feedback enables students to quickly address learning difficulties and improve their understanding of physics. Furthermore, AI analyzes learning data, identifying student patterns, curriculum weaknesses, and optimizing teaching strategies (Baidoo-Anu & Ansah, 2023). These insights inform effective learning programs. However, implementing AI in physics learning presents

advancements, ensuring students receive cutting-edge education.

The transformative power of Artificial Intelligence (AI) is revolutionizing various industries, including education. However, the education sector has yet to fully harness AI's potential. Within academia, AI is reshaping traditional learning methodologies, offering personalized experiences and improving educational outcomes. AI tools like chatbots are being leveraged to provide tailored guidance, disseminate educational resources, and enhance decision-making processes (Miao *et al.,* 2024). Despite AI's growing influence, debates among educators about its adoption for blended learning remain incongruent. While some enthusiasts tout AI's benefits, skeptics highlight concerns about its effectiveness and potential drawbacks. This dichotomy underscores the need for a balanced discussion about AI's prospects and challenges in education, particularly in Nigeria, where the adoption of AI for blended learning is still in its infancy.

Statement of the Problem

Teaching and learning physics in tertiary institutions face challenges such as inadequate teachers, outdated methods, and student disengagement, leading to poor performance and low interest in physics-related careers. Traditional teaching methods often fail to cater to the diverse learning needs of students, leading to a disconnect between teaching and learning. Furthermore, the increasing student-teacher ratio and limited resources exacerbate the problem. To address these challenges, Artificial Intelligence (AI) can revolutionize physics education by providing personalized learning experiences, automating grading and feedback, enhancing student engagement, and developing intelligent tutoring systems. This study aims to explore AI's transformative-tools in tackling these challenges, explain the potential AI-transformative tools in tackling the challenges faced in teaching and learning physics in tertiary institutions, identify AI-Transformative Tools that can be used to tackle the challenges faced in teaching and learning physics in tertiary institutions and identify the challenges that can be faced in using AI-Transformative Tools to teach physics in tertiary institutions. By harnessing the potential of AI's transformative tools, this study seeks to improve student performance, increase engagement, and develop a more effective and efficient physics education system, ultimately bridging the gap between teaching and learning physics in tertiary institutions.

Objectives of the Study

The main objective of this paper is to explore AI-Transformative Tools in tacking the challenges faced in teaching and learning Physics in tertiary institution in Nigeria. The specific objectives are highlighted as follows to:

1. Explain the concept of Physics
2. Explain the concept of Artificial Intelligence
3. Explain the potential AI-transformative tools in tackling the challenges faced in teaching and learning physics in tertiary institutions

4. Identify AI-Transformative Tools that can be used to tackle the challenges faced in teaching and learning physics in tertiary institutions
5. Identify the challenges that can be faced in using AI-Transformative Tools to teach physics in tertiary institutions

Conceptual Clarifications

Concept of Physics

Physics is a vital branch of science that plays a significant role in our daily lives. It is a fundamental subject in science-oriented courses like engineering, medicine, and mining. Students pursuing careers in sciences and engineering must have a strong foundation in physics, having excelled in the subject at the secondary school level. Physics helps learners comprehend the world around them, enabling

quality. Traditional assessment methods have limitations, such as oral exams and written tests, which can neglect individual abilities. The process of developing and implementing educational systems, particularly traditional assessment methods, requires significant time and resources. In many ways, AI offers improvements over these conventional methods. Research by Martin, Davis & Hogg, (2019) highlights that AI can boost the accuracy, validity, and reliability of assessments, reduce biases, and create adaptive assessments tailored to individual needs. Additionally, AI can identify patterns and trends that are difficult for humans to detect, thereby enhancing the overall quality of education. The application of AI in education holds great potential, especially in improving the learning experience. However, it's essential to recognize that AI is merely a tool, and final decisions in the learning process must remain in human hands. As such, AI must be used wisely to foster positive developments in education. While the advantages of AI are clear, its use should be approached cautiously to avoid potential risks. AI-supported education, including intelligent learning systems, advanced virtual environments, data analytics, and predictive capabilities, is becoming increasingly vital as educational demands grow. Such intelligent systems offer personalized training and timely feedback for both educators and students. Moreover, a variety of computational technologies, particularly those related to machine learning, are deeply connected to statistical models and cognitive learning theories.

Potential of AI-Transformative Tools in Tackling the Challenges Face in Teaching and Learning Physics.

Artificial Intelligence (AI) possesses immense potential to revolutionize the education sector by harnessing AI technology to significantly enhance various aspects of education. In the realm of technology, innovation is a crucial aspect that drives human progress, particularly In educational processes and methods, one rapidly growing innovation is the incorporation of Artificial Intelligence, as proposed by Gao, Liu, & Li, (2020). AI represents a groundbreaking innovation in technology that synergizes computer algorithms and data processing to form a system capable of adaptation through experiential learning, as stated by Kahng & Cho, (2019). The application of AI in education, particularly in learning assessment processes, has captured the interest of numerous education experts, researchers, and practitioners. Several studies demonstrate that AI in education can significantly improve student outcomes, especially in evaluation and providing accurate and measurable feedback. AI technology in education and assessment has the potential to reduce errors and improve the precision of evaluations. By identifying the specific needs of both students and teachers, AI can make educational processes more efficient. Traditional methods in education, however, have certain limitations, such as the reliance on human judgment, which may lead to inconsistent outcomes and a decline in quality. Conventional assessment methods, like oral exams and written tests, often overlook individual student abilities. The development and implementation of traditional assessment systems require significant time and resources. In several ways, AI offers more effective solutions compared to traditional approaches. According to research by Martin, Davis, & Hogg, (2019), AI can

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enhance the accuracy, validity, and reliability of assessments, reduce biases, and

personalize learning experiences that cater to individual needs. Additionally, AI can detect patterns and trends that humans might miss, leading to improved learning outcomes. The integration of AI in education offers various potential benefits, particularly in enhancing the quality of learning. However, it is important to note that AI is merely a tool in the learning process, with the ultimate decision-making power remaining in human hands. Therefore, AI must be applied thoughtfully to ensure it contributes positively to the advancement of education. While the benefits of AI are clear, its use must be carefully managed to avoid potential risks. AI-assisted education, which includes intelligent systems, advanced virtual learning environments, data analytics, and predictive capabilities, is becoming increasingly important as educational demands grow. These intelligent systems provide personalized feedback and training

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C. Robot: Robots can be employed to measure and determine extremely high temperatures within craters. A key advantage of using robots for this purpose is their ability to conduct experiments in hazardous environments that are inaccessible to humans.

D. High Performance Computing (HP):The technology that enhances learning both inside and outside the classroom, facilitating comprehension of both theoretical and experimental physics concepts. Assignments can be conveniently distributed via cell phones. Students can capture and upload basic experiments related to physical phenomena in their surroundings, providing valuable instructional materials for class discussions. This approach holds the potential to motivate students and foster a more dynamic learning environment.

E. Chatbot Einstein: Chatbot Einstein is one of the alternative medium to study and understand physics concepts leveraging Dialog flow technology, chatbot platforms can serve as interactive teaching and learning tools by facilitating question-and-answer sessions with students. Students can utilize the chatbot's logging capabilities to assess their learning outcomes.

F. Chat GPT: Chat GPT is one of AI platforms which has the potential to answer questions about different Challenges arise when using images to identify obstacles due to the need for accurate and concise image descriptions. Additionally, ChatGPT responses may require verification as the model struggles with unclear image inputs.

G. Physics learning tutor: Artificial Intelligence (AI) can serve as a virtual tutor, guiding students towards a deeper understanding of physics concepts. Implemented in several countries, AI facilitates student engagement in scientific inquiry and learning. Through AI-powered platforms, students tackle various problems, seeking solutions by analyzing real-world phenomena. Instant feedback on incorrect answers encourages iterative problem-solving until correct solutions are achieved. The combination of immediate feedback and visual representations of real-world events significantly enhances students' learning experience and grasp of physics concepts.

Challenges of Using AI-Transformative Tools

Addition to the opportunities and advantages that AI offers, there are several challenges that must be considered when implementing this technology. According to findings from a literature review of existing research, various challenges arise in

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the use of AI technology. One significant challenge is ensuring the validity and reliability of AI. The application of AI in education requires it to deliver highly valid and reliable outcomes, offering consistent and objective results. However, this remains a challenge, as AI has yet to fully replicate and adapt to the complexities of human intelligence. Furthermore, the quality of data used in AI systems must be carefully managed and regulated to guarantee accurate outcomes. These are some of the likely challenges that can face in using Artificial intelligence transformative tools.

1. Ensuring the accuracy and dependability of AI in education is crucial: AI technology must deliver consistent and unbiased outcomes, which is a challenging task due to AI's limited ability to replicate human intelligence. Moreover, the data utilized in AI must be meticulously managed and

outcomes and perpetuating systemic inequalities, as highlighted by Kim, (2021). It is essential to address these biases to ensure AI promotes equity and inclusivity in education.

5. The opacity of AI systems, stemming from their intricate nature, poses a significant challenge in detecting and addressing errors or biases: This lack of transparency and accountability can erode trust in AI-driven educational tools, ultimately compromising their efficacy in supporting student learning. As Rudolph, Gibson, & Lee, (2020) highlight, the complexity of AI systems can hinder our ability to identify and rectify issues, underscoring the need for transparent and accountable AI design to foster trust and ensure effective educational outcomes.

6. Limited domain knowledge: AI systems may not possess the same level of domain-specific knowledge as human teachers, which can limit their ability to provide high-quality educational experiences (Hwang, Xie, & Shu, 2020; Chen, Lai, & Lu, 2018).

7. Inability to replicate human interaction: AI systems lack the human touch and may not be able to replicate the complex social interactions that occur between teachers and students (Raca, Tormey, & Dillenbourg, 2017).

8. AI systems are susceptible to perpetuating entrenched biases: If they are trained on data that is skewed or prejudiced. This can result in unfair decision-making in educational contexts, where AI may inadvertently reinforce existing inequalities. As in Chouldechova, (2017) point out, biased training data can lead to AI-driven decisions that systematically disadvantage certain student groups, underscoring the need for vigilant data curation and AI design to ensure equitable educational outcomes.

9. Limited accessibility: AI systems may not be accessible to all students, particularly those with disabilities or limited access to technology (Smith, Ho, & Kumar, 2017).

10. The efficacy of AI systems in educational settings hinges on their ability to evolve and adapt through continuous training and updates: However, this necessitates a significant investment of time and resources, as highlighted by Zhang, Wang, & Liu, (2019). The need for ongoing maintenance and refinement of AI systems can be a resource-intensive endeavor, requiring sustained efforts to ensure these systems remain current, accurate, and effective in supporting student learning outcomes.

11. The integration of AI in education necessitates careful consideration of

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ethical implications: Including the risk of perpetuating biases and discrimination against marginalized student groups. As Bostrom and Yudkowsky, (2014) pointed out that, AI systems can inadvertently reinforce existing inequalities, exacerbating ethical concerns. Ensuring AI-driven educational tools are designed with fairness, transparency, and accountability is crucial to mitigate potential harm and promote equitable learning environments.

12. Teacher training: Teachers may need training to effectively integrate AI into their teaching practices, which can be time-consuming and costly (Wen, 2020).

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crucial role in directing and facilitating effective physics learning and this paper reveals the limitations of algorithms in educational assessment particularly concerning for minority groups, who are often disproportionately affected by inaccurate results. This highlights the importance of understanding AI as a complementary tool to augment teaching, rather than a replacement for it. To fully leverage the benefits of AI in the classroom, educators require comprehensive training to effectively integrate these technologies and ensure they are used in a way that promotes equity, accuracy, and student-centered learning.

Recommendations

The study proposes the following strategies to promote the integration of Artificial Intelligence (AI) in Physics teaching at tertiary institutions:

1. Equip teachers with AI tools: Provide teachers with necessary AI tools to facilitate effective Physics instruction.
2. Incentivize AI use: Motivate teachers to utilize and innovate with available AI resources for Physics teaching.
3. Enhance teacher training: Offer comprehensive training programs to equip teachers with AI skills.
4. Create a conducive AI environment: Adapt the school infrastructure and culture to support AI integration.
5. Foster student-AI interaction: Encourage students to engage with AI tools during Physics classes.
6. Improve laboratory facilities: Equip physics laboratories with modern learning materials to enhance interactive learning and student performance.
7. Strengthen ICT curriculum: Incorporate ICT courses into the curriculum to develop students' technological skills for effective learning across science subjects.

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