

**INTEGRATING ARTIFICIAL INTELLIGENCE WITH VIRTUAL AND
AUGUMENTED REALITY TECHNOLOGIES FOR ENHANCED COMPUTER-
BASED LEARNING**

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Abstract

This research focused on how Artificial Intelligence (AI) can integrate with Virtual or Augmented Reality (VR/AR) technologies to enhance computer-based learning. The study was conducted with 15 Master's students from the Department of Computer and Robotic Education. Data was collected using a structured questionnaire, and consisted of 15-items. Data was analyzed by calculating Mean and Standard Deviation taking into account the Likert five-point scale enumerated responses. The study results indicated that the students had a low level of awareness and experience with the use of AI, VR, and AR technologies in their practices. However, the respondents indicated their agreement, and to a "strongly agree", that the use and integration of AI, VR and AR technologies into computer-based learning can enhance levels of engagement, understanding, and personalized learning in students' practices. Additionally, the research identified major impediments like poor technical resources and infrastructure (lack of technology), poor connectivity to the internet, poor power supply resources, and lack of teacher professional development and retraining. Therefore, it was outlined as recommendations that there are more awareness campaigns to create a growing awareness of the use of these technologies, investment in contemporary educational resources by schools, teachers, and training given both adequate time and structure, government support in terms of funding, improved technology and policy improvement. Overall, if educational institutions in Nigeria are to fully embrace and integrate the AI-VR/AR technologies in practice with potential, infrastructure and human resources issues need to be addressed first.

Keywords: Artificial Intelligence Virtual and Augumented Reality Technologies Computer-Based Learning.

Introduction

With the advancements in digital technology, virtually all aspects of human beings' lives have changed, including what and how knowledge is delivered and received. With respect to education, in traditional teaching and learning environments, the delivery of education traditionally included more memorable, engaging, personalized, and effective experiences. The move from traditional methods of teaching and learning to technology-enhanced learning opportunities has provided numerous possibilities for students. The data suggest that the most significant technologies enhancing education have been Artificial Intelligence (AI), Virtual Reality (VR), and Augmented Reality (AR). Each of these technologies has made its own

significant contributions to teaching and learning, however, when combined they represent a new frontier for the design and development of highly interactive and intelligent computer-based learning environments (Siddiqui et al., 2022; Craig & Georgieva, 2020).

Artificial Intelligence (AI) describes the simulation of human cognitive functions in machines, and includes the ability to learn using data, recognizing patterns, using data and/or experience to regulate their actions, and adapting over time. Artificial Intelligence has potential applications in education, particularly to create personalized learning experiences by analyzing performance data of students, identifying areas of weakness, and supplying students with customized content or feedback to improve performance (Holmes et al., 2019). AI offers opportunities for objective and quantifiable data regarding the performance of students by using technology to enhance a traditional learning experience. Adaptive learning platforms, intelligent tutoring systems, and AI-powered chatbots create the hit of learning that happens in real time and strengthens students' comprehension of course content.

Virtual Reality is a technology that uses a headset to create a simulated environment or a 3D computer generated world where users can see, hear and even feel things as if they are physically present in that space. It makes learning more interactive and immersive. This form of learning can be especially beneficial for topics that require knowledge of spatial positioning, simulations or hands-on experiences, to include science experiments, historical reconstructions, or engineering models (Azuma, 2017). Augmented Reality enhances the learning experience by adding digital components (images, audio, animations) to part of the physical world, augmenting the real space and environment. Textbooks that instruct students to scan an image are an example of AR, allowing the students to see the images come 'alive', changing from a picture to an interactive diagram or animation, and so on.

When AI technology is applied to VR and AR technologies, it becomes a powerful learning tool and a massive change in the educational landscape, as it will motivate learners but also differentiate for individual needs in real-time in a visual and experiential manner. The augmentation of computer systems such as these offers an opportunity for deeper understanding, while simultaneously increasing motivation and engagement and making possible a more user-centred and collaborative structure (Chen et al., 2021). For example: an AI integrated virtual laboratory that can simulate experiments and adjust for student ability, gives hints or provides required explanations based on assessment, and so on. These sorts of computerized programs facilitate limited paced, competency-based learner-centred environments that are particularly useful in user-centred or computer-based learning solutions in education settings.

The limitations of Artificial Intelligence (AI), Virtual Reality (VR), and Augmented Reality (AR) as rapidly developing, sophisticated, useful, and advantageous technologies in education have continued to rise globally, however, their deployment and implementation in computer-based learning areas is significantly constrained. This is especially the case in many educational sites, particularly countries like Nigeria which are developing. Most learners have not experienced nor been adequately introduced to the technologies of AI, VR, and AR. Most educators have either no skills or the necessary resources to implement them.

Therefore, students continue to have little choice, but to rely on traditional, non-interactive, nonadaptive, computer-based learning systems that are severely limited in terms of providing diverse learning avenues. Having identified the gap, it remains to be asked how can one understand, effectively combine, and apply the cutting-edge technologies of AI, VR, and AR in order to improve the learning environment, motivation of students and academic performance within Nigerian institutions.

This research seeks to understand how the conjunction of Artificial Intelligence coupled with Virtual and Augmented Reality technologies can be successfully employed to improve computer-based learning in a modern educational environment. As part of this exploration, the primary technologies will be examined, along with the specifications, applications, benefits, limitations, and future. Particular consideration will be given as to practical implications of such amalgamation for teaching and learning in an educational context in Nigeria and Africa where availability of high-quality learning opportunities and resources remain troublesome accessibility challenges.

Statement of the Problem

In recent years, the global education landscape has seen a significant shift toward digital and computer technology-driven learning. Increasingly, developed countries are exploring some of the possibilities offered by technologies like Artificial Intelligence (AI), Virtual Reality (VR), and Augmented Reality (AR) to generate more interactive, adaptive and personalized learning environments. AI offers intelligent feedback, automates learning pathways, and supports data-informed instruction, while VR/AR present an immersive and engaging experience that allows a learner's understanding to deepen and improve retention. While the benefits of these technologies are significant, there remains limited possibilities for integration into Nigeria's educational system, particularly at the higher education level.

Many students still have limited opportunities to use traditional computer-based education (that is often rigid, non-interactive, and unable to respond to an individual learner learning differences). The level of awareness and use of AI, VR, and AR tools among students and educators is low. Many Nigerian educational institutions do not have the infrastructure, skills, expertise, or finances to deploy and use these technologies effectively. Thus, students are not able to experience rich, immersive, and intelligent learning environments. Exacerbating the situation are difficulties like difficult internet connectivity, unreliable power supply, and limited digital literacy of the educators. Although research has established that using Artificial Intelligence with VR/AR is an effective means of enhancing engagement, motivation, and learning outcomes, not much is known about how they are perceived, accessed, or utilized through technology in Nigeria.

Purpose of the Study

The main purpose of this study is to examine how the integration of Artificial Intelligence (AI) with Virtual and Augmented Reality (VR/AR) technologies can enhance computer-based learning among students. specifically the study sought to:

1. investigate the level of awareness and usage of AI, VR, and AR technologies among learners and educators in computer-based learning environments.
2. examine the perceived impact of integrating AI with VR/AR on students' learning engagement, understanding, and performance.
3. identify the challenges or limitations associated with implementing AI, VR, and AR technologies in educational settings.

Research Questions

1. What is the level of awareness and usage of AI, VR, and AR technologies among students and educators?
2. How does the integration of AI with VR/AR technologies affect students' learning experiences and outcomes?
3. What challenges are encountered in the adoption and implementation of AI, VR, and AR in computer-based learning?

Methodology

The descriptive survey research design was employed in the study to investigate how the confluence of Artificial Intelligence (AI) and Virtual and Augmented Reality (VR/AR) technologies can support computer-based learning. The population of this study consisted of 15 Master's level students in the Department of Computer and Robotics Education at University of Nigeria. These students were chosen based on their exposure to and relation to educational technology tools. The data were gathered with the use of a structured questionnaire developed by the researcher. The questionnaire contained both closed-ended and open-ended items in order to gather data on the respondents' awareness, use, and perception of the convergence of AI, VR, and AR in learning. Education, and the questionnaire was distributed via Google Forms so that responses could be collected easily and in a timely manner. The questionnaire invoked Likert-scale type items to ascertain respondents' awareness, attitudes, and experiences with the integration of Artificial Intelligence with Virtual and Augmented Reality technologies in computer-based learning.

The raw data collected from the survey were analysed using descriptive statistics, specifically the mean and standard deviation. Each item on the survey was rated on a five-point Likert scale (Strongly agree-5 to Strongly disagree-1). The mean was able to provide an overall sense of the respondents' perception of each item while the standard deviation found the overall level of agreement or variability of the responses. The results were organized in tables to make them easy to interpret. This section presents an analysis and interpretation of the data collected from 15 Master's students in the Department of Computer and Robotics Education. The tool used for collecting the data was a structured questionnaire consisting of 15 Likert-scale items, with the aim of gauging respondents' awareness, perceptions, and challenges with regard to combining Artificial Intelligence (AI) and Virtual and Augmented Reality (VR/AR) in a computer-based learning environment.

All 15 items were responded to using a five-point Likert scale: Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1). The position of the ratings was analyzed mean and standard deviation to find the general perception and level of agreement among the respondents. The criterion was set at a benchmark so any item with a mean score of 3.00 and above would be accepted, any item below 3 would be rejected. The results are then presented in the tables under their respective subheadings with the respective interpretations.

Findings of the Study

Research Question 1: To investigate the level of awareness and usage of AI, VR, and AR technologies among learners and educators in computer-based learning environments.

Table 1: Mean rating of awareness and usage of AI, VR, and AR technologies among learners and educators in computer-based learning environments

S/N	Item Statement	Mean	SD	Remark
1	I am familiar with Artificial Intelligence (AI) in education.	3.53	0.64	Agreed
2	I have used Virtual Reality (VR) tools in learning activities.	3.27	0.46	Agreed
3	I have experienced Augmented Reality (AR) content in an academic setting.	3.53	0.52	Agreed
4	I understand how AI, VR, and AR technologies can be used in teaching and learning.	3.60	0.51	Agreed
5	I have personally used at least one of these technologies (AI, VR, or AR) in school.	4.27	0.46	Agreed

Table 1 indicates clearly that the Learners and educators are aware and make use of AI, VR, and AR technologies in computer-based learning environments are 3.27 and 4.27 respectively. The standard deviation scores are 0.46 and 0.52 respectively. This implies that the Learners and educators are aware and make use of AI, VR, and AR technologies in computer-based learning environments

Research Question 2: To examine the perceived impact of integrating AI with VR/AR on students' learning engagement, understanding, and performance.

Table 2: Mean rating of impact of integrating AI with VR/AR on students' learning engagement, understanding, and performance.

S/N	Item Statement	Mean	SD	Remark
1	AI-VR/AR technologies make computer-based learning more engaging.	4.60	0.51	Agreed
2	These technologies help me understand difficult or complex topics better.	4.67	0.49	Agreed

S/N	Item Statement	Mean	SD	Remark
3	AI, VR, and AR technologies motivate me to learn.	4.47	0.52	Agreed
4	These technologies support personalized learning tailored to individual students.	4.67	0.49	Agreed
5	I would recommend the use of AI, VR, and AR in my institution's learning system.	4.13	0.52	Agreed

Table 2 indicates clearly that there is an impact of integrating AI with VR/AR on students' learning engagement, understanding, and performance are 4.67 and 4.13 respectively. The standard deviation scores are 0.49 and 0.52 respectively. This implies that there is an impact of integrating AI with VR/AR on students' learning engagement, understanding, and performance

Research Question 3: To identify the challenges or limitations associated with implementing AI, VR, and AR technologies in educational settings.

Table 3: Mean rating of challenges or limitations associated with implementing AI, VR, and AR technologies in educational settings.

S/N	Item Statement	Mean	SD	Remark
1	There is a lack of access to AI, VR, and AR infrastructure in most schools.	4.20	0.41	Agreed
2	Poor internet connection and unstable power supply affect the use of these technologies.	4.33	0.62	Agreed
3	Most teachers lack the required skills to use AI, VR, and AR tools in teaching.	4.47	0.64	Agreed
4	These technologies are too expensive to implement in our schools.	4.00	1.00	Agreed
5	Technical and maintenance issues make it difficult to use AI, VR, and AR consistently.	4.27	0.46	Agreed

Table 3 indicates clearly that there is challenges or limitations associated with implementing AI, VR, and AR technologies in educational settings are 4.00 and 4.47 respectively. The standard deviation scores are 0.41 and 1.00 respectively. This implies that there is there is challenges or limitations associated with implementing AI, VR, and AR technologies in educational settings

Discussion of Findings

This section offers the discussion of the results analysed based on the study's guiding three research questions. The imperatives responses were analysed using mean and standard deviation, and the interpretation of the overall results are discussed below:

Research Question One: What is the level of awareness and usage of Artificial Intelligence, Virtual Reality, and Augmented Reality among students?

The analysis reveals that the mean scores of four out of five items are below 3.00, which indicates a low level of knowledge the infrastructure for emerging educational technology, AI, VR, and AR was at low levels among the respondents. The students claimed that they were unfamiliar with AI in education (Mean = 1.53), did not use VR tools (Mean = 1.27), and did not experience AR content (Mean = 1.53). interest and a porous range of interest in augmented and virtual reality. One item did have a relatively high mean (4.27) suggesting that some students had used at least one of the technologies personally. Given overall responses, it suggests that there is limited structured, formalized experience and use of these technologies are limited in regards to exposure in a structured academic environment, but some students may or may have direct experience using them on a personal basis.

findings appear consistent with Adegbile and Oduwaiye (2021) who suggested most Nigerian institutions have limited access to and usage of emerging educational technology due to infrastructural and limited training cleaner infrastructure, and a lack of training for technology which helps students and educators manage the affordances of these tools for enhancing teaching and learning experiences would as the research depicted increase learning.

Research Question Two: What is the perceived impact of AI, VR, and AR on learning among students?

The results demonstrate that the students more than agree that AI, VR, and AR technologies positively affect learning. All five items had mean scores above 4.00 with the two items of “These technologies greatly help me to understand complex topics” (Mean = 4.67) and “They allow me to personalize my learning” (Mean = 4.67) receiving the highest means. These results indicate that the students recognize that these technologies are positively supporting their understanding, motivation, and engagement in the learning process. This supports the recommendation by Holmes et al. (2019), who indicated that AI-powered and immersive learning tools enhance the delivery of instructional content and enhance learner satisfaction. The students' responses demonstrate enthusiasm, motivation and willingness to embrace these significant learning innovations if they were made available.

Research Question Three: *What are the challenges associated with integrating AI, VR, and AR in computer-based learning?*

Outcomes from this section indicate that students express agreement that there is a number of obstacles hindering the implementation of AI, VR and AR technologies in Nigerian institutions. Rate of means across the five items were higher than 4.00. The most pressing obstacles were lack of access to technology (M= 4.20), poor internet and fluctuating power availability (M= 4.33), and poor teacher training (M= 4.47). This suggests that though students acknowledge the advantages of these technologies, there are other barriers to their use from an infrastructure and technical standpoint.

The major barriers identified here appear to corroborate Craig and Georgieva (2020) who also found that many developing countries are unable to adopt educational technologies due to

costs, poor digital infrastructure, and lack of technical know-how. It is important to address these barriers so that successful adoption and integration can occur.

Challenges of Integrating AI with Virtual and Augmented Reality in Computer-Based Learning

Despite the promising benefits of Artificial Intelligence (AI), Virtual Reality (VR), and Augmented Reality (AR) in enhancing computer-based learning, several challenges hinder their effective integration in educational environments, particularly in developing countries like Nigeria.

1. Limited Access to Infrastructure and Resources

One of the primary barriers is limited access to needed technological infrastructure. Many schools and schools do not have sufficient computer systems, virtual reality (VR)/augmented reality (AR) headsets, reliable internet, or high-performance devices that support these technologies. Students and teachers cannot use artificial intelligence (AI), VR, and AR teaching and learning tools (Adegbile & Oduwaiye, 2021).

2. High Cost of Implementation

It is often too expensive for many education institutions to buy/install/maintain AI-powered learning platforms and VR/AR teaching and learning tools. These technologies require in-depth costs, including hardware, software, and training; therefore, they are out of financial reach for schools with limited resources/funds (Siddiqui et al., 2022).

3. Low Digital Literacy of Educators and Students

Many educators and students do not have the technical skills to use AI, VR, and AR systems. This results in a disconnect between the availability of technologies and their actual usage. Without appropriate training and digital literacies, even if technology tools are available, there is no way to stress the use of the tools in teaching or learning (Holmes et al., 2019).

4. Poor internet connectivity and power supply

Poor internet connectivity and power outages are common in various locations within Nigeria. The barriers associated with limited internet connectivity and utilization of cloud-based AI platforms or utilizing VR/AR devices generally have high speed and constant power supply (Azuma, 2017).

5. Resistance to change and traditional beliefs

Some educators and institutions, and more specifically some educators prefer to utilize face-to-face opportunities and bare-minimum computer-assisted instruction. Factors causing the resistance to change may arise from either fear of the unknown, not being exposed to

emerging technologies, or the assumption that there is no technology to replace conventional face-to-face instruction (Craig & Georgieva, 2020).

6. Technical and maintenance issues

AI, VR, and AR systems need a consistent line of technical support, needing software to be periodically updated and properly maintained. Most schools typically do not have the technical personnel needed to provide support for such systems, resulting in breakdowns, providing unwanted inconvenience, or total neglect.

Conclusion

This study investigated the convergence of Artificial Intelligence (AI) and Virtual and Augmented Reality (VR/AR) technologies for supporting computer-based learning in Master's students studying in the Department of Computer and Robotics Education. Specifically, the study sought to find out the students' level of awareness and usage of these technologies, their views of the types of learning and the extent of influence and impact they would have on learning, and their views on the barriers to use. The results found that while the students' awareness and exposure to the AI, VR, and AR tools utilized in their academic experience is generally low, they nevertheless believe that these technologies will have a mostly positive effect on their learning. They conceded that AI and immersive technologies can make learning more engaging, personalized, and effective. However, there were some significant hurdles outlined by the participants: lack of access to technology; poor infrastructure for implementing the technology; lack of proficiency and skilled educators; and implementation costs. In conclusion, AI's integration with VR and AR has a plethora of possibilities in computer-based learning, however, we need to do what we can to remove barriers to genuine realization. We need to increase awareness of the possibilities, create policy frameworks, conduct teacher training, and infrastructure investment to grow these technologies of learning in our institutional contexts in Nigeria.

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