Overview of Mixed Reality Technology for an Improved Distance Learning Education in Nigeria

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ABSTRACT

Education is said to be the this bedrock of the society, an agent of social engineering that aims to draw out ones inborn potentialities for personal and societal good but this viable too of socioeconomic development that have evolved from its primitive classroom, face-to-face teacher- learner interactions to a more dispersed distance learning paradigm where learner and teachers interact remotely has experienced a major setback as it is inhibited by the its inability to deliver practically oriented discipline like in the core sciences, engineering and others. This paper therefore reviews the evolution in distance learning in Nigeria in line with the sustainable development goal four (4) and proposes the implementation of mixed reality technology as a tool to bridge the gap between theoretical oriented distance learning program to an all-encompassing, interactive and engaging theory cum practical oriented distance learning approach that will provide the opportunity for student and learners to enrol for disciplines in the core sciences and engineering with practical hands-on virtual experience.

Keywords: Distance learning, Education, AI, Mixed Reality, Augmented Reality, Virtual Reality

INTRODUCTION

The application and deployment of computers and related technology in the different spheres of human endeavour has brought about massive growth and productivity across the industry, socio-political and economic divide. Today this technology has provided the platform for improved collaboration on the global scale, enhanced resource sharing, mobilization and utilization in e-commerce, governance, learning and much more. Life and living in the twenty first century would be vague without the use of information and communication technology tools as it has virtually miniaturized the once dispersed global landscape into a virtual community without any known geographical boundaries making the world a global village with the great benefits.

The implementation of computer-based technology in education has brought about enhanced performance in the educational sector with state-of-the-art facilities and tool that has made the teaching and learning process easy and enjoyable for the teachers, instructors and the learners or students at all levels. From computer aided learning and instructions to assessments, the once tedious traditional learning and assessment process has been demystified and improved with high level accuracy in assessment and performance evaluation. Furthermore, the application of computers and information technology tools in the teaching and learning process has not only improved performance of the product of the educational process in terms of the quality of reaching and the graduates, it has also enhanced scholarship with a wide range of instructional and academic materials available from vast spectrum making it easily accessible and available to all irrespective of their location, status and creed.

The evolution of the teaching and learning process from the traditional or conventional classroom system to the correspondent programme and now the distance learning programme has in no small measure transformed the educational service delivery process and enhance the capacity of many who would not have had the opportunity to physically receive such life transforming instructions based on many limiting factors. Conversely, this continuous development in the technology deployed has driven the educational process to a new approach that

is more attractive to both the teachers and students, making it possible to deploy new tools leading to an evolution in the teaching and learning process in a number of ways with changing global viewpoint [20][1].

The advent of distance learning in Nigeria was greeted with a high level of excitement as it was seen as an opportunity for many to finally acquire higher education that has eluded them by reason of time and other inhibiting personal concerns, unfortunately this learning process has not been fully maximized as professional, technical and practically oriented courses like medicine and engineering cannot be implemented on the present distance learning platform. There is therefore the need to bridge the gap between theoretical and practical skill to provide hands-on practical experience required in an ever-evolving global stage.

This chapter aims to review the current distance learning platform in Nigeria with a view to propose a more enhanced technologically driven approach to the teaching and learning process using mixed reality technology. The objectives are to review the current distance learning program in Nigeria, explore available technological innovation in the teaching and learning process, review mixed reality technology and its advantages in education and evaluate the advantages of mixed reality against conventional distant learning paradigm.

RELATED LITERATURE

The traditional teaching and learning process which entail the assembling of teachers and learners in a well-defined location has undergone several mind-blowing transformations in the last three decades as a result of the application of computers and related technologies in the teaching and learning process. This domain like others have been drastically invaded in the right direction with information technology tools and solutions that would have been better imagined in a Hollywood science fiction movie but fortunately, it is real and evolving with an unassuming a speed. Today's teaching and learning is changing in number always along with altering global outlook.

Education being a continuous process of leading out one's inborn potentialities for personal and societal good includes the development of motor and cognitive skills through the teaching and learning process. [3], asserts that education as an instrument of social engineering is a transformative tool necessary for the actualization of personal and national goals by inculcating core values of national integration and development. It bridges the gap between the world of the known and the unknown possibilities for drastic change and innovative development. The teaching and learning process cm the other hand is the conveyor of the goods inherent in the education to the learner consequently evoking behavioural change.

[16], considers education as a fundamental public good that should be accessible to all and sundry irrespective of geographical or ethnic divides. Furthermore. education has evolved from the traditional classroom paradigm where a teacher or instructor stands before the students and gives his/lesson on a given subject matter to dispersed teaching and learning process where individual students can access educational/ instructional materials remotely without actually being in an organized classroom setting beyond physical border. This is in line with the United Nations (UN) sustainable development goal four (4), which advocates for an inclusive, equitable and accessible quality education that promotes lifelong learning. The learning process advocated by this fifteen year plan of the united nations (UN) sustainable development goal which runs from 2015 to 2030 aims to provide for equal and affordable access to vocational training devoid of gender and wealth discrimination to ensure a global access to higher education which most developing countries has over the years had lower enrolment rate due to economic and cultural drawback (Nations (UN, 20)5). To be able achieve the fourth sustainable development goal by the year 2030 in Nigeria and other developing countries, distance education and learning would play a major role to deliver quality and innovative educational goods to the large population of people in rural settlements across the different geopolitical zones.

Distance learning

The evolving nature at' the twenty first century has greatly impacted every known area of human endeavour causing a drastic change in the way we live, work and play. Therefore, the answer to the challenges faced by the educational sector of the economy would include how information and communication technology could be deployed to provide the needed organizational and policy framework that could make technology effective [8].

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Distance learning represents the underpinning methodologies that allows for unrestricted access to educational resources and training, thereby liberating the learners from the limitations of time and geographical constraints. [21], states that distance education and learning provides the opportunity for remote students to learn from an institute Hun without attending formal classroom teaching session, making room for flexible learning experience for both the teachers and the learners. [10] defined distance education as a systematic educational activity, which encompasses the choice, preparation and presentation of teaching materials as well as supervision and support of students' learning which is achieved by bridging the physical difference between the students and teachers by means of at least one appropriate data. This learning paradigm offers flexible learning opportunities to individual and group teaching and learning process. This Form of education is growing astronomically as it affords inure people the opportunity to acquire quality higher education. The growth and development in information technology can be attributed to this massive expansion in distance learning. One key contribution of information technology to distance learning is the evolution and growth of the internet as an open resource repository where the teachers can reach the learners seamlessly without the known limitation of time and geography [8].

Distance learning in Nigeria

It is factual that distance education has been of great advantage to the educational sector in Nigeria as it has served as a deliberate mechanism in the extension of educational services to its vast array of clients who previously have not been served. The growing demand for educational services and the corresponding supply dynamics has contributed to the level of acceptance, growth and subsequent implementation of open and distance education programmes in Nigeria as a means to bridge the gap between the ever-increasing educational demand and supply [2].

Though challenging, this form of education enhances the teaching and learning process and bridge the gap the developed and developing economies. The establishment of the National Open a university of Nigeria (NOUN) and National Teachers Institute (NTI), both degree awarding distance learning institutions by the Nigerian government was applauded by stakeholders in the educational sector as it is intended to provide services to meet up with the enormous demands for formal education [18].

Historically, distance education in Nigeria could be traced back to the era of correspondence education whereby students and candidates preparing for the General Certificate in Education which a pre-requisite for the London Matriculation examination access learning material by mail. The education ordinance of 1882 of the British protectorate which Nigeria was a part of the protectorate enable the for the first set of Nigeria student in 1887 to enrolled for the University of London matriculation Examination as external students through correspondence studies without having any form of contact with the institution [19]. The correspondence programme of the University of London continued to progress and offered many Nigerians the opportunity for educational development until the first Nigerian university, the University of Ibadan was established in 1948. Subsequently in the same vein by 1950, the University of Ibadan began a part time course for workers in the faculty of education. The establishment of distance education took off in various universities under different names.

Application of Computer Technology in Distance learning

Advancement in computer and information technology has continued to transform distance education globally. Starting from the correspondence model of distance education where the main instructional medium was print, to the development of synchronous (two-way, real time interactive technologies) such as audio teleconferencing, audio graphics conferencing and video conferencing, it is possible to link geographically dispersed learners and instructors for real time [17]. In addition, the asynchronous feature of computer-mediated communications on the other hand has been associated with the ability to accommodate time schedules of distance learners.

[4], opines that as distance education is technology-driven, there is therefore the need for a developing nation like Nigeria to provide necessary infrastructure for technological development as it poses a threat to distance education. For instance, it has been observed that with the rapid increase in the number and variety of educational products (hardware and software) and the evolving nature educational technologies (technical tools and services change) there is also the need to overhaul the traditionally slow bureaucratic organizational processes and structures of universities that has proven difficult to adapt to this drastic change. The development and

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implementation of computers and information technology in distance education has further created more access to educational resources stored on remote severs giving learners the opportunity to leverage on technology enabled content via telecommunication medium [10].

Artificial Intelligence technologies for Distance learning

Modern computers have been designed to function beyond the mere garbage – in – garbage out paradigm but to work and act intelligently like human and carry out functions in like manner. Researchers and scholars in the field of artificial intelligence and its different subset made this possible. Artificial intelligence (Al) is a subfield of computer science that aims at the design and development of computers that are competent to carry out activities that are generally done by humans: basically, acting intelligently in those activities. [13] Artificial Intelligence technology has made it possible for the development of machines that can learn by experience and respond accordingly to both internal and external influence and effects. With the increasing impact of artificial intelligence technology in today's world with ground breaking research and products like autonomous or self-driving cars, Chabot on Facebook, and personal assistance like Amazon Alexa, the implementation of Al in E and distance learning will facilitate learner control of the learning process with the potential to monitor progress [9].

[23], further opines that the technology can also be implemented for the enhancement of the distance learning process through smart learning contents, intelligent tutoring systems, virtual facilitators, learning environment and content analytics. [27], avows that implementation of artificial intelligence in distance learning can improve the timelessness of the entire educational system by setting multiple intelligent agent systems in the computer that will have more high-end processing capabilities, through mutual cooperation between the various subsystems and greatly reduce the information processing time. This intelligent agent technology allows computers to take autonomous adaptation for new things and environmental, and take the process and integration of information and make effective completion a series of actions in the instruction

OVERVIEW OF MIXED REALITY TECHNOLOGY

Immersive Reality Spectrum

Immersive Technology is the integration of virtual content with the physical environment that allows the user to engage naturally with the blended reality. Immersive reality (XR) encompasses the entire spectrum of improved learning experiences, from augmented reality to virtual reality. Immersive virtual reality aims to provide a complete 360-degree experience by transporting people into digital 3D surroundings. We may engage with and explore virtual worlds in a realistic manner by using technologies such as virtual reality headsets and tracking controllers.

According to the February 2022 World Economic Forum white paper, immersive reality creates or imitates the physical environment through digital simulation, providing the user with a new approach to experience and comprehend the connected concepts. It further state they also combine virtual and physical content, which facilitates user interaction with blended reality. The fact that AR and VR technologies have assisted in closing academic gaps occasioned by the global COVID-19 pandemic should be viewed with optimistically [22]. These technologies provided a variety of services to aid in the successful transformation of remote education into a more immersive experience. In an immersive experience, the user accepts virtual elements of their environment as part of the whole and become less conscious that those elements are not part of physical reality [7].

Virtual Reality

Virtual reality (VR) is an emerging technology with applications in many fields, including education, training, industrial design, architecture, urban planning, space exploration, medicine and rehabilitation, entertainment, defence, and research in many scientific fields. It offers a new way to see and experience information that is both dynamic and immediate. It is a technology that is thought to be a natural extension of 3D computer graphics, with improved input and output devices [1]. Through its ability to create a digital environment that completely substitutes the learner's physical surroundings, virtual reality provides students, teachers, and leaders with a

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variety of rich, experiential learning opportunities. Virtual reality content is accessed via Head-Mounted Displays (HMDs), which are typically goggles or a helmet with a tiny monitor in front of each eye that causes visuals to appear in 3D. Most HMDs now feature a head hacker that responds to head movements, so that each movement one makes, left or right, the image is altered to mirror the direction moved, making it appear as if you're looking at a new pan of virtual reality [7]. According to [26], virtual reality provides a user with a 100% 3D virtual experience that removes all components of the real world. It suggests that virtual reality does not provide the user with a real-world vision, but rather an animated virtual enthronement.

Augmented Reality

Augmented reality (AR) is an emerging field of technology in education, with research suggesting that integrating AR in education leads to deeper student involvement, improved learning performance, and learning motivation. AR changes and enhances real life by using computer-generated images and sounds. For example, point your smartphone's camera at something that an app recognises to make a 3D animation or video superimposed over whatever is on your camera's screen. The augmented reality system superimposes computer-generated pictures and data over the real world [24]. Augmented reality enables the real-time overlay of virtual graphics on a real-world or live environment. It smoothly bridges the gap between the real and virtual worlds by extending the real-world environment with computer-generated virtual imagery [15]. It is a blend of contextually relevant real world and virtual data that provides users with access to important audio-visual content that can be used easily and efficiently. In augmented reality, virtual data can include text, music, and video, and these virtual items are perceived to exist in the real world [6].

Augmented reality technology has been developed and applied in the teaching and learning processes with a high success rate in environmental sciences, microbiology, and medicine, thereby improving students' knowledge of the subjects taught. As this technology has gotten more compact and engaging to an immersive experience via personal computers and mobile devices, numerous instructional approaches utilising AR technology have become more viable [15][6]. The Following components basically are required for the efficient implementation of augmented reality technology for effective teaching and learning process;

A video camera to capture live images,

Significant storage space for virtual objects,

A powerful processor to either composite virtual and real objects or display a 3D-simulated environment in real time and

an interface that allows the user to interact with both real and virtual objects.

Augmented Virtuality

Augmented virtuality is a technique for enriching a virtual environment with information from the actual world, with the goal of connecting the virtual to the real world and providing a more cognitive context. For the examination of historical locations in AV, many augmentations can be used. In more complicated settings, the 3D reconstructions and sceneries are inhabited with various human actors, also recreated in 3D, with the goal of portraying a more realistic depiction of historical architectural places [12].

Mixed Reality

Mixed reality (MR) is an improvement on augmented reality (AR), projecting spatially aware and responsive 3D digital material. A ball can bounce off tables, walls, or disappear under a couch when it becomes a virtual item. MR is significantly more ambitious than AR in that it blends digital information into our surroundings and allows us to manipulate it as if it were a physical object. Mixed reality (MR) is similar to virtual reality (VR), but it encompasses a larger idea than augmented reality (AR), which augments the real environment with synthetic electronic data. On the other hand, augmented virtuality (AV) refers to the process of enhancing or augmenting the virtual environment (VE) with data from the actual world. [24] define mixed reality as an artificial intelligence field that spans a spectrum from augmented reality to augmented virtuality.

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[12] define mixed reality as the confluence of the real and virtual worlds, with the potential for adoption in education and training due to its advantages over augmented reality and virtuality. MR improves user perception and engagement with the actual environment and has been shown to be useful for use in the teaching and learning process. [26] also contends that there is no apparent distinction between augmented reality and mixed reality because both depict an environment that combines virtual reality things with real-world ones. Mixed reality is a hybrid of virtual and augmented reality. From his perspective, the distinction between mixed reality and augmented reality is minor, since it still refers to a broader idea of augmented reality that enhances the deliverables by augmented reality with greater accuracy and precision. Figure 1 depicts the link and interaction of augmented reality, virtual reality, and mixed reality.

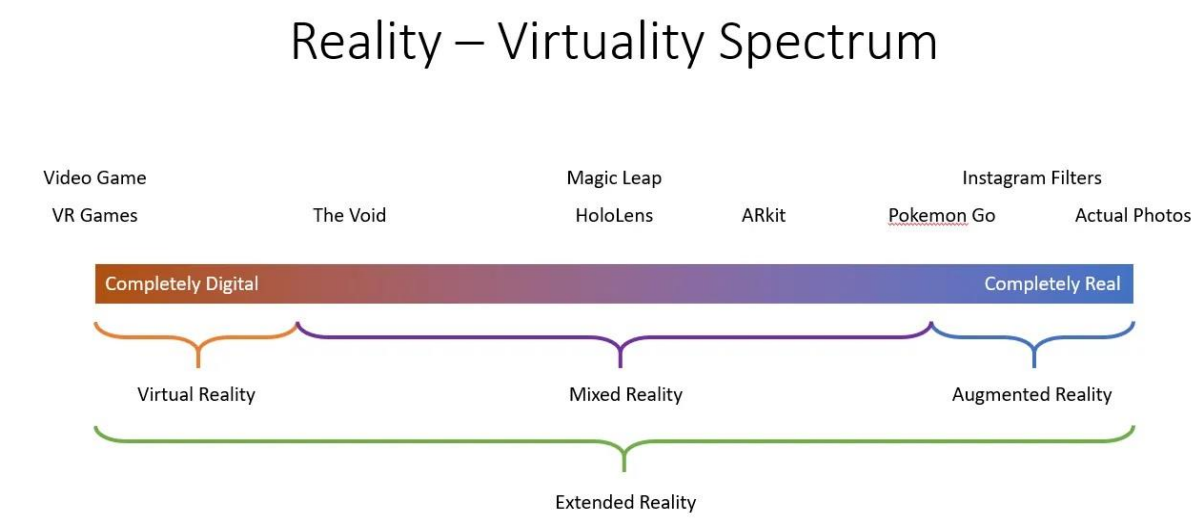

Fig. 1. Reality Virtuality Spectrum (Source: Burnett, 2019)

Advantages of Mixed Reality in Distance Learning

The following are some of the notable advantages of mixed reality technology;

It is a low-risk alternative to carryout real-world experiments

It gives opportunity for hands-on practical experience

It is interactive and engaging

It can be used to learn complicated procedures especially in medicine without any form of complications

The application of mixed reality (MR) technology in the enhancement of distance learning encourages active students/ learner participation and real-time feedback, which can be especially helpful for the learners, including those with learning disabilities. By integrating MR into the learning process, students become more engaged and are given hands-on opportunities to explore concepts more deeply, making it easier for them to understand and remember what has been taught [25].

Mixed Reality (MR) has demonstrated considerable potential in enhancing educational outcomes by improving the processes of learning, communication, and collaboration. It is particularly effective for students who experience challenges in traditional learning environments, enabling them to achieve improved academic performance through immersive and interactive experiences. The usefulness of MR was particularly evident during crisis situations, such as the COVID-19 pandemic, when students were able to continue their education remotely and without significant disruption. This capacity for uninterrupted learning highlights MR's value in maintaining educational continuity during unforeseen events [5].

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Moreover, MR equips educators with innovative tools to increase student engagement. It fosters active participation during instructional sessions, supports stronger interpersonal connections, and facilitates a more intuitive understanding of subject matter by allowing learners to visualize and interact with content, rather than relying solely on verbal or written descriptions. Through MR, students can experience simulated historical events, explore complex systems, or engage with reconstructed environments and figures, thus enriching their educational experience.

Additionally, MR helps overcome geographical and logistical barriers, contributing to safer learning environments and more cost-effective instructional delivery for educational institutions. As digital technologies continue to evolve, the integration of MR into educational frameworks is becoming not only more prevalent but also increasingly essential for effective and inclusive teaching and learning practices.

DISCUSSION

Distance learning has significantly improved access to education, allowing more people around the world to pursue lifelong learning through online programs offered by various institutions. While this approach has many benefits, it still faces important limitations especially when it comes to providing hands-on experience, which is essential in fields like medicine and engineering. That's where mixed reality (MR) and augmented reality (AR) come in.

These emerging technologies are already being adopted in industries like engineering and healthcare research to demonstrate complex concepts and experiments that would be difficult or impossible to replicate in a traditional classroom setting. According to [11], MR makes it more affordable to simulate real-world scenarios in educational environments, helping students to gain practical understanding without the high costs of physical labs or equipment.

Mixed reality has various advantages over traditional remote learning approaches. It facilitates interactive training, enables remote teamwork, improves instruction and task visualisation, and aids design and decision-making. One of the primary strengths of mixed reality (MR) is in its ability to bring abstract theories to life by allowing students to interact with content spatially and physically, making learning more immersive and memorable. Furthermore, MR tends to avoid some of the disadvantages of full virtual reality (VR), such as motion sickness, blurred vision, and disorientation, which can occur when users are fully immersed in a virtual environment [14].

CONCLUSIONS

The implementation of mixed reality (MR) technology in D stance education and learning process enhances the learning process with interactable 3D models which helps to achieve much higher degrees of skills and knowledge. When images come alive and concepts can he felt by the learner, it creates an environment for immediate experimentation of concepts, encourages its verification and reinforce the concepts and ideals taught iii the class making education more engaging with the resultant behavioural alteration. It also promotes the learning of skill by practical experience which encourages lifelong learning in line with the UN sustainable development goal four (4) which aims to achieve inclusive, equitable and accessible quality education that promotes lifelong learning by 2030.

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