

**IMPACT OF VIRTUAL AND AUGMENTED REALITY ON
STUDENTS' MOTIVATION AND INTEREST IN INTEGRATED
SCIENCE**

BY

**Blessing OHARISI
EDU1803160**

**DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL
TECHNOLOGY
FACULTY OF EDUCATION
UNIVERSITY OF BENIN
BENIN CITY**

OCTOBER 2023

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**A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF
CURRICULUM AND INSTRUCTIONAL TECHNOLOGY, FACULTY
OF EDUCATION IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE AWARD OF THE DEGREE OF
BACHELOR OF SCIENCE EDUCATION (B.Sc. Ed) DEGREE IN
INTEGRATED SCIENCE, UNIVERSITY OF BENIN, BENIN CITY.**

OCTOBER 2023

CERTIFICATION

We, the undersigned, certify that this study was carried out by Blessing OHARISI in the Department of Curriculum and Instructional Technology (CIT), Faculty of Education, University of Benin, Benin City.

.....
DR. F. O. AHANOR

Project Supervisor

Date:

.....
DR. (MRS.) A.H. OYAKHIROME

Project Coordinator

Date:

.....

DR. F.O. IDEHEN

Ag. HEAD OF DEPARTMENT

Date:

DEDICATION

This project is dedicated to God Almighty for His divine mercy and grace that saw me throughout my study in the University of Benin.

ACKNOWLEDGEMENT

Firstly, the researcher wish to express her sincere gratitude to her project supervisor Dr. F. O. Ahanor for his understanding, good relation and sacrifices. His true directive, encouragement and guidance brought this work to this wonderful conclusion. Indeed, words are not enough to show her appreciation. She pray that God will continue to bless him.

The researcher wishes to acknowledge Dr. F. O. Idehen Ag. Head of Department, Department of C.I.T for his fatherly role. Appreciation also goes to project coordinator Dr. (Mrs.) A. H. Oyakhirome and other lecturers in C.I.T. Department.

This is the time to show invaluable appreciation and gratitude to those who in one way or the other contributed towards the researcher educational success. In this regard, the researcher tends her gratitude to her parents Dr and Mrs Joe Oharisi for their prayers and financial support throughout her years in the school. To her uncle Mr Ayodele Obaseemo for his constant encouragement and prayers through out her study.

The researcher is also grateful to her sister Miss Victory Oharisi for her financial support and prayers as well as her friend Miss Judith Ohwojeroh for her care and love. Thank you all for being an essential part of this journey.

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ABSTRACT

This study was to investigate the impact of virtual and augmented reality on students' motivation and interest in Integrated Science. The instrument used for data collection was questionnaire, which was developed and administered to 20 students from 5 junior Secondary Schools in Ovia North East local government area of Edo state. The data from their responses were analyzed with the use of simple percentage.

The result revealed that using virtual reality in learning science increases the interest in the subject and it makes science more engaging and enjoyable, the impact of augmented reality on students' motivation and interest positively influences and improves their understanding and attitude towards learning science. Virtual and augmented reality enhances motivation to engage in studying science and it makes learning science more interesting. VR and AR enhance students' participation in science, improves their understanding of scientific concepts and increases their motivation to learn about science, while some limitations of VR and AR are expensive technology and resources, also VR and AR might distract students from the actual scientific content by focusing on the technology itself

It is therefore recommended that Education authorities and institutions should consider integrating VR and AR applications into the science curriculum. Schools should invest in the necessary hardware and software infrastructure to support VR and AR in classrooms. Developers should create high-quality, curriculum-aligned VR and AR content for science education. Efforts should be made to ensure equitable access to VR and AR resources, especially in underserved communities to bridge the digital divide in education.

CHAPTER ONE

INTRODUCTION

Background of the Study

Science education is crucial for equipping students with the knowledge and skills necessary to understand the natural world, engage in scientific inquiry, and make informed decisions in a technologically advanced society. However, traditional approaches to science education often struggle to captivate students' interest and maintain their motivation throughout the learning process.

Traditional methods of teaching science primarily rely on textbooks, lectures, and two-dimensional visuals, which may not effectively engage students or foster deeper understanding. Students often find it challenging to grasp abstract scientific concepts without hands-on experiences and real-world connections. As a result, there is a growing recognition of the need for innovative instructional approaches that can enhance students' motivation and interest in science education.

In recent years, virtual reality (VR) and augmented reality (AR) technologies have emerged as promising tools in education, with the potential to revolutionize the way science is taught and learned. VR creates a simulated, three-dimensional environment that immerses users in virtual worlds, while AR overlays virtual elements onto the real world. These technologies offer interactive and immersive learning experiences that can enhance students' understanding, engagement, and motivation in science education.

VR and AR technologies have unique features that can address the limitations of traditional science education approaches. By providing virtual environments and interactive simulations, these technologies can offer hands-on experiences that are otherwise difficult or impossible to replicate in a traditional classroom setting. Students can explore scientific concepts, conduct virtual experiments, visualize complex phenomena, and interact with virtual objects, thus bridging the gap between theoretical knowledge and real-world applications. Moreover, VR and AR technologies can cater to diverse learning styles and preferences. They provide visual and auditory stimuli, kinesthetic interactions, and opportunities for active learning, which can accommodate different students' needs and increase their engagement and

motivation. By creating an immersive and interactive learning environment, VR and AR technologies have the potential to spark curiosity, stimulate critical thinking, and deepen students' understanding of scientific concepts.

Many countries are seriously investing in integrating technology into the education system to ensure the quality of education and train their citizens according to the needs of modern society (Topuz & Göktaş, 2015). Various technology-producing countries, especially the U.S. and EU countries, have begun to use technological developments in education. However, to get the most out of technology, it is necessary to properly understand education and training based on virtual and digital technologies.

While there is growing interest in the use of VR and AR in science education, there is still a need for empirical research to investigate their impact on students' motivation and interest. Understanding how these technologies affect students' learning experiences, attitudes, and outcomes in science education is essential for educators, curriculum developers, and policymakers to make informed decisions about their integration into classrooms.

Although AR has been used for years with the help of computers, today it is used in many different applications in mobile and portable devices due to the changes and developments in the technological field. Thanks to the development of AR technology, it has been used in all fields in recent years. AR is used in various fields such as the automotive industry, military, medicine, tourism, construction, architecture, sport, entertainment, engineering, assembly, navigation, museology, maintenance, product design, telerobotics, marketing, and advertising (Altinpulluk, 2019; Fidan & Tuncel, 2019; Ong, Yuan & Nee, 2008). After successful results in these fields, the usage areas of AR technology have increased day by day. AR is also used in education, and many researches have been conducted in this field in recent years. With the widespread use of mobile devices, the applications of AR, which are used in education, are updated and their number is rapidly increasing. AR applications are also designed to work with more and more different devices and systems as technology advances. For example, AR applications have begun to be used in wearable tech products as well as mobile devices. With the use of AR applications in education, beneficial content is put into a fun and interesting form and presented to students. The use of AR

in education is a very important development in terms of effectiveness, efficiency and accessibility in teaching and learning process. AR is a popular technology that has added a new dimension to education and has become the focus of educational research in the last decade (Ibáñez & Delgado-Kloos, 2018; Sirakaya & Alsancak Sirakaya, 2020). A good many studies have highlighted trends, benefits, opportunities, challenges, and impacts of AR technology on education. The most important point in using AR technology in the classroom is that it is appropriate to the level of the students and the curriculum of the course, and the process is carried out regularly. Moreover, this technology provides opportunities for learning experiences and teaching processes by creating an interactive and immersive environment (Bujak et al., 2013; Dunleavy, Dede & Mitchell, 2009; Fidan & Tuncel, 2019). Unlike traditional methods and techniques, the use of technology in science education with AR applications is of great importance to schools where the laboratory environment is not accessible. Therefore, the AR technology can also be used as supplementary or evaluative material, especially in the context of laboratory or workshop studies and virtual classroom activities

This research project aims to contribute to the existing body of knowledge by examining the impact of VR and AR on students' motivation and interest in science education. By exploring the potential benefits and limitations of these technologies, the study seeks to inform educators and policymakers about effective strategies for integrating VR and AR into science curricula, ultimately enhancing the quality of science education and fostering a lifelong interest in scientific inquiry among students.

Statement of the Problem

The statement of the problem in this research project focuses on the limitations and challenges of traditional science education methods, which often fail to fully engage students and maintain their motivation and interest in the subject. It addresses the need to explore innovative strategies, specifically virtual reality (VR) and augmented reality (AR), to enhance science education and investigate their impact on students' motivation and interest.

Some specific issues that the statement of the problem aims to address include:

Lack of Engagement: Traditional teaching methods, such as lectures and textbooks, may not effectively engage students in science education. This lack of engagement can lead to decreased motivation and interest, hindering students' ability to develop a deep understanding of scientific concepts.

Abstract Nature of Science: Science often deals with abstract and complex concepts that can be challenging for students to grasp without hands-on experiences and real-world connections. Traditional methods often fall short in providing such opportunities, resulting in reduced interest and motivation to learn.

Limited Interactivity: Traditional teaching approaches typically lack interactivity, preventing students from actively participating in the learning process. This passive learning environment can lead to decreased engagement and reduced motivation to explore scientific concepts further.

Inadequate Visualization: Visual representation plays a crucial role in science education. However, traditional 2D visuals, such as diagrams and illustrations, may not effectively convey the depth and complexity of scientific phenomena. This limitation can impact students' understanding and interest in science.

Need for Innovative Pedagogical Tools: With the advancements in technology, there is a growing need to explore innovative pedagogical tools that can enhance science education. Virtual reality and augmented reality offer immersive and interactive learning experiences that can potentially address the limitations of traditional methods.

By identifying and addressing these issues, the research aims to contribute to the field of science education by investigating the potential of VR and AR technologies to improve students' motivation and interest. Understanding the impact of these technologies can help educators and policymakers make informed decisions about integrating them into science curricula and designing effective learning experiences that foster a love for science among students.

Research Question

The following research question were made to help with the study

1. What is the impact of virtual reality on students' motivation and interest in science education?

2. What is the impact of augmented reality on students' motivation and interest in science education?
3. How do virtual and augmented reality compare in terms of their impact on students' motivation and interest in science education?
4. What are the potential benefits and limitations of integrating VR and AR into science education?

Purpose of the Study

The general purpose of this study is the impact of virtual and augmented reality on students' motivation and interest in science education in Egor local government area of Edo state. The study tends to;

- Explore the specific impacts of virtual reality on students' motivation and interest in science education
- Explore the specific impacts of augmented reality on students' motivation and interest in science education
- Examine the comparative effectiveness of virtual reality and augmented reality in relation to students' motivation and interest in science education

- Identify the potential advantages and drawbacks of using these technologies in science education

Significance of the Study

The study will invariably be of tremendous importance to students, teachers and researchers in science accordingly. The findings of this research will:

- Provide insights into the effectiveness of VR and AR technologies in enhancing students' motivation and interest in science education.
- Inform the development of innovative teaching strategies and educational materials that leverage VR and AR technologies.
- Help educators and policymakers make informed decisions regarding the integration of VR and AR into science curricula.
- Contribute to the existing literature on the use of immersive technologies in education and bridge the gap between theory and practice.

Scope and Delimitation of the Study

The scope of the study is to carry out the impact of virtual and augmented reality on students' motivation and interest in science education. The study is therefore delimited to junior secondary school in JSS3 of government schools in Egor Local Government Area of Edo State Nigeria.

Definition of Terms

Virtual Reality (VR): refers to a technological environment that immerses users in a computer-generated simulation of a three-dimensional (3D) world.

Augmented Reality (AR): refers to a technological concept that overlays digital information, such as images, videos, or 3D models, onto the real world, enhancing the user's perception of reality by seamlessly integrating virtual elements with their physical surroundings.

Motivation: refers to the internal drive or desire that influences and directs an individual's behavior and actions towards achieving a goal.

Interest: refers to a feeling of curiosity, engagement, or attraction towards a particular subject or topic.

Science Education: refers to the teaching and learning of scientific concepts, principles, and practices in formal educational settings.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter focuses on the review of related literature. And it will be discussed under the following sub-headings:

- Concept of VR
- Concept of AR
- Virtual and Augmented Reality in Science Education
- Comparative Effectiveness of Virtual Reality and Augmented Reality.
- Impact of VR on Students' Motivation and Interest
- Impact of AR on Students' Motivation and Interest
- Comparism of VR and AR on Students' Motivation and Interest
- Benefits and Limitations of VR and AR in Science Education
- Summary of Reviewed Literature

Concept of VR

Virtual Reality (VR) is a concept that has garnered significant attention in recent years, impacting various fields, from entertainment and gaming to education and healthcare. The concept of VR can be traced back to the mid-20th century when pioneers like Morton Heilig and Ivan Sutherland laid the

foundations for immersive technologies. However, it was not until the late 20th century that VR became accessible to a broader audience with the development of more affordable and sophisticated hardware and software.

Virtual Reality or VR allows a user to interact with a computer-generated three-dimensional model or virtual environment. This environment may be realistic, in the sense that it is familiar to us at a macroscopic scale, it may be realistic in the sense that it depicts the physical world as known to science but which is not usually observable, or it may be used to visualize a world that is entirely imaginary. As such, VR is broadly applicable, and has been applied to, many different areas of education including the sciences, archeology, history and architecture.

The advantage of VR over conventional methods of description is that the student is given the opportunity to experience subject matter that would be difficult if not impossible to illustrate or describe with conventional methods. Modern education often requires a student to comprehend complex or abstract concepts or appreciate scenarios and situations that no longer exist. To this end, common mechanisms for teaching abstract concepts are the use of metaphor and analogy, especially within the sciences. By using an analogy

we describe an event or abstract concept in terms of commonly observable reality. That is, we relate concepts to experience. The experience provides the material for the construction of a mental model of the concept, which in turn leads to the foundation of knowledge (Duffy & Jonassen, 2018). Humans learn by having experiences, by interacting with their environment and using their senses to derive information from the world. Virtual reality is a technology that replaces sensory input derived from the real world with sensory input created by computer simulation. It provides interactivity by responding to movements and the natural behaviors of humans in the real world. In this respect VR may prove to be a powerful resource that can help in teaching by providing an environment that allows the student to experience scenarios and situations rather than imagining them. The experiential nature of VR systems derives from three sources: immersion, interactivity and multi-sensory feedback. Immersion means being enveloped or surrounded by the environment. The benefit of immersion is that it ensures a sense of presence or the feeling that one is really in the depicted world (Schuemie, 2011). Interactivity is the ability to control events in the simulation by using one's body movements which in turn initiates responses in the simulation as a result

of these movements. The multi-sensory nature of VR means that information can be derived from more than one sense and adds to the experience by making it more believable, engaging (adding to the sense of presence) and providing redundancy of information which reduces the potential for ambiguity and confusion. Sensory combination reinforces information from two or more sensory sources. The aim of VR is therefore to replace the real world with a virtual world and to allow the user to behave as if they were in the real world. The experiential nature of VR supports a constructivist approach to learning (see Winn, 1993). Constructivism is a theory of knowledge acquisition that states that humans construct knowledge by learning from their experiences. As popularized by Jean Piaget the theory states that the learner attempts to assimilate new experiences within their already established world model. If the learner cannot successfully assimilate new detail, they change their world view to accommodate the new experience. When we act on the expectation that the world operates according to our world model and it does not then we must accommodate the new experience by reframing our model of the way the world works; we learn from the experience. This implies that learning is a form of active hypothesis testing.

This should be contrasted with the view that learning is a passive accumulation or acceptance of facts. VR provides an environment for this active hypothesis testing and thus provides a powerful medium for learning. In general, and as suggested by Bruner (2016), students who actively engage with new material are more likely to retain this material and recall it at a later stage.

Concept of AR

AR is a technology that overlays digital information, such as images, videos, or 3D models, onto the real world. This blending of the virtual and physical realms enhances the user's perception of reality. AR's evolution can be traced back to the 1960s, with early iterations in the military and aerospace sectors. However, it gained mainstream attention with the advent of smartphones and wearable devices, which brought AR experiences to the masses.

The 'augmented' term of augmented reality (AR) has its origins from an essay written by Sutherland (2009) where the author predicts: "There is no reason the objects displayed by a computer have to follow the ordinary rules we are familiar with ...the user of a visual display could easily make solid

objects transparent. He can ‘see through matter’ [with] augmented reality urbanware” The term was first used to describe technology by Tom Caudell in 1990 while working on ways to visualise component information in aircraft construction at Boeing. In common with other virtual technologies, experimental prototypes were developed during the 1990s, with the first AR system developed by Louis Rosenberg at the US Air Force Research Laboratory in 1992. Today there are a variety of devices and technologies but most users experience AR as an application on their smartphone to display media combined with the image of the real world on their screen.

Typically, the media is triggered by scanning objects or images that match a previously captured image of the scene. Other triggers include dedicated logos, QR codes, location sensors, or system generated events such as responses to user queries, display of data streams or timed events. It is with these broader considerations in mind we move to the affordances of AR and the benefits and barriers to adoption in a range of learning contexts.

The defining feature of AR is that it is context sensitive, aware of its temporal, spatial, physical and virtual environment, operating at a specific time (temporal), place (spatial), and in response to particular / pre-determined

real time triggers (physical), or data input (virtual). In common with other virtual environments, it can respond to user interaction and direction so that the experience can be unique to the user. There are many applications of AR, but these can be usefully categorised into three broad and overlapping areas – content delivery, user content creation and data integration.

Many applications use AR to allow the visualization and 3D exploration of remote or difficult to see structures or components, which makes it ideal for content delivery and experiential learning in engineering, science, medicine, environment, architecture and historical education. In common with previously innovative, disruptive technologies, AR is extending from specialised developers and professional publishers to include hobbyists and casual creators within social media. Ranging from basic image filters to more sophisticated AR shopping experiences and development studios, Snapchat, Facebook and Instagram are providing users with AR creation and sharing facilities. This provides considerable opportunity for educationalists to develop collaborative projects that allow students to create and share their own artefacts in many different learning contexts.

A more technically advanced use combines image recognition with data analysis, enabling prototype systems to automatically identify triggers and associate overlay information; enabling large-scale integration of AR with existing information resources. Using AR as part of data analysis and visualisation can help illustrate and interpret results. For example, blood circulation data can be projected onto a patient's body to show blood flow issues from diseases such as diabetes; the inside of a nuclear reactor comes to life; teams working at critical incidents such as fire crews can 'see' how flames proliferate inside a building. Augmented Technology AR is made up of several continually developing technologies that fit within a continuum of virtualisation from none (real world) to complete (virtual world), where augmented reality and augmented virtuality are also known as 'mixed' reality.

Virtual and Augmented Reality in Science Education

When working with virtual reality (VR) it is essential to review the definitions of mixed reality, augmented reality, and virtual reality to portray our stand on these concepts. Mixed reality is a type of hybrid environment that blends the physical environment with virtual objects ([Tang et al, 2020](#)). It describes a linear continuum that ranges from real environments (reality) to

fully virtual environments (virtuality) (Milgram and Kishino, 1994 as cited by Tang et al., 2020). In mixed reality, the real and virtual contents allow for data contextualization, they provide real-time interactivity, and the content needs to be mapped and correlated with the 3D space (Tang et al., 2020). Within this continuum, we find augmented reality, which integrates virtual objects into real-life environments, usually using devices such as smartphones or wearable smart glasses (Chuah, 2018). The real-life environment and the virtual objects interact through the augmented reality device in real-time (Dodevska & Mihic, 2018). For example, when taking a real-life picture with a camera on a smartphone, AR can attach virtual objects to the photograph (Sahin and Yilmaz, 2020). It has been found that augmented reality helps students to visualize abstract concepts, allowing them to observe phenomena that would be impossible otherwise (Sahin and Yilmaz, 2020).

At the end of the reality-virtuality continuum, we find virtual reality. VR blocks out the real world and creates a fully virtual setting to immerse the users into the virtual world (Chuah, 2018). Since VR represents only three-dimensional virtual environments generated with computers, it is necessary to use the appropriate hardware and software to experience VR (Dodevska and

Mihic, 2018). VR is an experience in which the user is physically in the real world, entering a three-dimensional virtual environment using a headset and a computer or with a mobile device (Frost et al., 2020). The VR market nowadays has contributed to academic research, engineering, and education, among other areas (Tang et al., 2020).

To design and develop VR learning experiences, it is necessary to consider key educational process elements, such as effective pedagogy, considering the time for teaching and learning activities, using appropriate tools and resources, and promoting student engagement (Tang et al., 2020). Buentello-Montoya et al. (2021) highlighted the importance of having an adequate pedagogical design when implementing VR and AR in the learning of mathematics. Research has found that virtual learning environments can enhance, motivate, and stimulate learning that the traditional approach could not achieve easily (Pan et al., 2006 as cited by Tang et al., 2020). Educational technologies can improve science courses by implementing effective scientific activities and bringing students closer to abstract situations that are difficult to recognize in real life (Sahin and Yilmaz, 2020). The development of virtual experiences in science teaching should be

designed to enhance student learning and motivate positive attitudes in students.

[Dodevska and Mihic \(2018\)](#) highlight some advantages and disadvantages of using VR. As advantages, VR can help make decisions in complex projects, reduce time and efficiency, and provide simulations that could lower costs and improve experiences. The main disadvantages are that the initial costs of the hardware and software requirements and changing platforms may not be quite straightforward.

Virtual and Augmented Reality In Science Education

Virtual environments are becoming relevant for science education in different areas, such as computer science education ([Broisin et al., 2017](#)), nanotechnology education ([Xie and Lee, 2012](#); [Schönborn et al., 2016](#)), biology education ([Poland et al., 2003](#); [Paxinou et al., 2020](#)), building sciences education ([Setareh et al., 2005](#)), health science education ([Chou et al., 2001](#)), chemistry education ([Miller et al., 2021](#)), among others. Research suggests that VR can be effectively implemented as a virtual class for web-based science education ([Shin, 2002](#)). Pre-service science teachers become

aware of the potential advantages and disadvantages of using virtual reality within a classroom setting after using a multi-user virtual environment (Kennedy-Clark, 2011). Cowling and Birt (2018) emphasize the need to put pedagogy before the technology to create mixed-reality simulations that satisfy students' pedagogical needs with a design-based research approach.

The trends in mixed reality studies show that most studies focus on learning achievement, motivation, and attitude and that there is a lack of qualitative research in this area (Arici et al., 2019). Most research compares students' learning outcomes when using VR to other approaches such as AR, hands-on experiences, and/or traditional education. Research suggests that VR is more effective for visual educational content, while AR is a better option for auditory learning (Huang et al., 2019).

The research has found no significant differences in learning outcomes between VR, AR and hands-on experiences. Research has shown that hands-on activities performed in virtual and physical environments are equally effective in producing significant learning outcomes regarding learners' knowledge and confidence in early science education (Klahr et al., 2007).

Other studies have found that there is parity between using hands-on learning and virtual reality in learning outcomes and cognitive processes (Lamb et al., 2018). In the teaching of medical sciences, several studies have found that there is no significant difference in learning outcomes between using VR, AR or tablet-based simulations; however, using VR participants reported adverse effects, such as dizziness (Moro et al., 2017a,b, 2021).

However, when comparing the use of VR with traditional approaches, the literature reports learning gains. McElhaney and Linn (2011) found that students experiment with virtual environments as intentional, unsystematic and exhaustive experimenters, and that these students had significant learning gains on physics understanding. Collaborative embodied learning in mixed-reality environments leads to increased learning gains compared to regular instruction in science learning (Johnson-Glenberg et al., 2014; Johnson-Glenberg and Megowan-Romanowicz, 2017). Using whole-body, immersive simulations of critical ideas in physics leads to significant learning gains, high engagement, and positive attitudes toward science (Lindgren et al., 2016). Using VR in the science classroom improves academic achievement and engagement scores compared to traditional courses (Liu et al., 2020).

Several studies have found that the use of VR improves specific abilities and attitudes in science students. Implementing a 3D Virtual reality learning environment improved female students' physics achievement and motivation toward physics learning (Al-Amri et al., 2020). Scherer and Tiemann (2012) found three problem-solving abilities in virtual environments, achieving a goal state, systematic handling of variables, and solving analytical tasks. Motivation and students' learning attitudes in immersive virtual environments for science education are related through the constructs of intrinsic value and self-regulation, while students' attention and enjoyment relate to students' learning in the immersive virtual environment (Cheng and Tsai, 2020). Implementing a Virtual Engineering Science Learning Lab (VESLL) has proven to improve student interest and learning experience in STEM education (August et al., 2016).

Güney (2019) highlights the relevance of visualization and visual literacy in instructional design for implementing technology in learning environments through a literature review on visual effects, visual literacy, and the design of multimedia instruction. Using a haptic virtual model with visual and tactile sensorimotor interactions may provide students with the

opportunity to construct knowledge about submicroscopic phenomena (Schönborn et al., 2011). Using VR environments and technology for science learning, it is essential to consider students' spatial acuity, since the learners' cognitive development plays an important role in students' perception of virtual reality (Hite et al., 2019). In the learning of mathematics, Schutera et al. (2021) highlighted the relevance of using AR in developing spatial visualization when learning vectors.

Comparative Effectiveness of Virtual Reality and Augmented Reality

Virtual Reality (VR) and Augmented Reality (AR) are immersive technologies that have gained significant attention in various fields, including education, training, entertainment, and healthcare. Both VR and AR offer unique experiences and opportunities for users to interact with virtual or augmented environments. However, when it comes to comparing the effectiveness of VR and AR, several factors need to be considered.

Immersion and Presence: VR provides a fully immersive experience by completely replacing the user's real-world environment with a virtual one. This high level of immersion can lead to a strong sense of presence and

engagement. On the other hand, AR overlays virtual elements onto the real world, allowing users to interact with both virtual and real objects simultaneously. While AR may not provide the same level of immersion as VR, it offers a more seamless integration with the real world.

Context and Application: The effectiveness of VR and AR can vary depending on the context and application. VR is often favored for simulations, training, and experiences that require a complete virtual environment, such as virtual tours, medical training, or complex simulations. AR, on the other hand, is well-suited for applications that require real-time interaction and augmentation of the real world, such as educational overlays, industrial maintenance, or navigation assistance.

Learning and Skill Acquisition: VR and AR have shown promising results in enhancing learning and skill acquisition. VR's immersive nature allows users to practice and experience scenarios in a controlled environment, facilitating experiential and hands-on learning. AR, on the other hand, can provide real-time information and guidance, supporting users in performing tasks and

acquiring knowledge in real-world contexts. Both technologies have demonstrated benefits in improving learning outcomes and skill development.

Accessibility and Cost: Accessibility and cost are important considerations when comparing VR and AR. VR typically requires specialized hardware, such as headsets and controllers, which can be expensive and may limit widespread adoption. AR, on the other hand, can be accessed through more affordable devices like smartphones and tablets, making it more accessible to a larger user base.

User Interaction and Collaboration: Both VR and AR offer unique opportunities for user interaction and collaboration. VR environments can be highly interactive, allowing users to manipulate objects, explore virtual spaces, and engage in collaborative activities with other users. AR enables users to interact with virtual elements overlaid on the real world, facilitating collaborative problem-solving, remote assistance, and shared experiences.

The comparative effectiveness of VR and AR depends on various factors, including the desired level of immersion, the specific application or context, the learning goals, accessibility, cost considerations, and the potential

for user interaction and collaboration. While VR offers full immersion and is well-suited for simulations and complex virtual environments, AR seamlessly blends virtual and real elements, making it suitable for real-time assistance and augmentation in real-world contexts.

Potential advantages and drawbacks of using technologies in science education

Different applications of information technology offer great benefits for students by bringing excitement to students and creating progress in relief and independence in their development. The proper use of information technology promotes and develops a variety of skills in students, such as mathematical skills, communication skills, critical thinking skills, problem solving, teamwork, and research skills (Reinhold et al., 2020). The benefit to students increasingly will depend on the skill with which teachers are able to use these tools. Given that these skills are unlikely to be used unless they fit with teachers' existing pedagogical beliefs, it is necessary that we increase our understanding of teachers' beliefs as part of our efforts to increase teachers' computer technology skills and uses. This will not only enable teachers to use

computers to their full potential but will enable students to reach theirs as well (Gilakjani, 2012). According to Borysiuk (2013) in his article “Benefits and disadvantages of the use of information technologies in education”, the benefits of using the information technologies are:

- increased interest in and overall motivation for education
- individualization of education
- objectivity of control
- activation of education through the use of attractive and rapidly changing forms of information presentation
- formation abilities and skills for the creative activities
- training of information culture;

Also, in his article Borysiuk (2013) states that the advantages of using information technology are:

- it creates a more interactive experience
- it provides unlimited resources
- it helps build necessary skills for the future
- it saves precious resources

- it instantly updates information
- it does not take up much space (Borysiuk, 2013).

Galle says information technology offers other educational advantages such as:

- increased credibility for the teacher
- instant access to numerous resources
- the automation of dull material
- the creation of a collaborative learning approach
- teaching core vocational skills with more ease
- the modernization of classrooms
- and affordability (Galle, 2018).

On the other hand, information technology may present problems for the preparation and delivery of classes. It can be a distraction, provide inappropriate access, and offer false information, make cheating easier, be expensive to maintain, and hinder basic skills (Borysiuk, 2013).

Information technology can also be difficult to integrate into lesson structures. For example, class schedules may not provide sufficient time for

Internet use during lessons. Also, teachers could become overly focused on creating visually attractive illustrative methods rather than lesson plans. Education on the basis of computer programs should not replace direct communication between teachers and students (Borysiuk, 2013). Regarding the disadvantages of information technology in education, Galle states that:

- it may be distracting to students
- it may disconnect students from face-to-face relationships
- it may make cheating easier
- it may disadvantage certain students
- it may cause students to use unreliable resources for learning
- it may make curriculum planning more difficult or expensive
- it may replace the teacher
- it may create privacy issues
- it may create medical issues
- it may create dependence (Galle, 2018).

A worrying problem is that information technology by students is often misused by students who spend hours on the computer and use it for pointless

things such as Facebook and various games. These children lack concrete guidelines to steer them into beneficial use. Family plays a major role in controlling the children while using the computer. Also, teachers play a very important role with their instructions which can stimulate students to use for educational needs. Psychologists Basov and Abram, as cited in Mexhuani (2014) shown that “children who play more games tend more to exaggerate the amount of violence in the world that surrounds them than those who play less” (Mexhuani, 2014). In addition, it was found that those children who play more games, tended more than those who played less, to accept the fear "when students tend to accept the fear of a bad person breaking into their homes ", or "when a random bad person could harm them ". Those who see a lot of movies and other programs that show criminal violence see their city as a dangerous place (Mexhuani, 2014). In the classroom, many teachers are turning to digital media to strengthen students’ basic skills. Using video and audio technology brings course materials to life in a way that stimulates young minds and facilitates learning. One reason for this improvement is that digital media tools can be used to address each student’s individual learning style, thereby empowering students to achieve their potential (Apple, 2002). The success of

innovative practices of technology use in schools is strongly related to the particular characteristics of each school. Infrastructure, equipment, a favorable school culture and the support from staff make the development of innovative practices with ICT easier (Sangrà & González-Sanmamed, 2010). Once students become familiar with technology, they quickly learn to use it proficiently. This opens up an exciting new world of learning possibilities for them, and their potential for achievement skyrockets. Students gain new skills and become familiar with new technologies that will help prepare them for future success in an increasingly technological world. Information technologies provide the opportunities of global interactions. Students can learn from interactions with the information, interface, teachers and co-learners using global networks (Hussain & Safdar, 2008, Shadiev et al., 2018).

Impact of VR on Students' Motivation and Interest

Over the last decade, several schools with the common goal of pushing educational innovation forward have invested in centers for educational innovation with a focus on emerging technologies ([Hidrogo, 2020a](#)). Some of the most popular emerging educational technologies are virtual reality,

blockchain, internet of things, artificial intelligence, among others. Particularly, virtual reality is in a crucial moment to be implemented massively, due to several reasons. Some characteristics of virtual reality make it a favorite candidate for its application for teaching and learning in schools; (i) as a technological tool, it can be directly applied to the teaching-learning process. (ii) Its current technological maturity stage has allowed for the development of hardware and software that can be incorporated into the educational context. At the same time, the costs have been generally reduced, making the incorporation into the educational context more viable. (iii) It can boost curiosity among students ([Hidrogo et al., 2020b](#)); and (iv) for most students, the school is the only place where they can access this technology.

Virtual environments are becoming relevant in different areas of science education, including natural, medical and computer sciences ([Chou et al., 2001](#); [Broisin et al., 2017](#); [Paxinou et al., 2020](#)). Many studies about the use of VR in science education focus on students' learning outcomes, motivation, and attitude when using VR ([Arici et al., 2019](#)). The literature reports no significant differences in learning outcomes when comparing VR with other active learning experiences ([Klahr et al., 2007](#); [Moro et al., 2021](#)),

but some studies do report learning gains when comparing VR with traditional learning ([Johnson-Glenberg and Megowan-Romanowicz, 2017](#); [Liu et al., 2020](#)). The literature on the use of VR about abilities and attitudes in science students reports improvements in students' achievement, interests and learning experience in STEM education ([August et al., 2016](#); [Al-Amri et al., 2020](#)). The relevance of the use of VR to improve certain scientific skills, such as visualization of abstract concepts, has been highlighted by some studies ([Güney, 2019](#); [Hite et al., 2019](#)).

The use of virtual reality in education has enabled the possibility of representing abstract concepts and virtually manipulating them, providing a suitable platform for understanding mathematical concepts and their relationship with the physical world. Many physical quantities, such as force and acceleration, are mathematically modeled with vectors for describing, computing, and predicting the physical world. Therefore, understanding and working with vectors is necessary for learning physics. The literature highlights the benefits of using VR in science learning. Different studies have reported the development of AR applications for learning vectors, their properties, and operations ([Martin-Gonzalez et al., 2016](#); [Langer et al., 2021](#)).

Impact of AR on Students' Motivation and Interest

The integration of technology in education has brought about significant changes in how students engage with learning materials. Augmented Reality (AR) is one such technological innovation that holds the potential to enhance students' motivation and interest in education. This literature review explores the impact of AR on students' motivation and interest in various educational contexts.

Motivation and interest are fundamental to effective learning. Students who are motivated to learn and have a genuine interest in the subject matter are more likely to be engaged and successful in their studies. Motivation can be intrinsic (stemming from personal interest) or extrinsic (driven by external rewards), and both play crucial roles in the learning process.

AR combines digital elements with the real world, creating an immersive and interactive learning environment. AR technology allows students to visualize complex concepts, engage in hands-on activities, and explore subject matter in a novel and captivating way.

Impact of AR on Students' Motivation and Interest

Enhanced Engagement: AR engages students through interactive experiences. The novelty of AR applications piques students' interest and motivates them to explore and learn more about the subject matter.

Personalized Learning: AR applications can be customized to suit individual learning preferences and pace. This personalization increases students' motivation by giving them a sense of ownership over their learning process.

Real-World Relevance: AR bridges the gap between abstract concepts and real-world applications. This connection to real-life scenarios often increases students' interest in learning, as they can see the practical relevance of what they are studying.

Multi-Sensory Learning: AR often incorporates visual, auditory, and kinesthetic elements, catering to various learning styles. Multi-sensory learning can enhance motivation by accommodating different student preferences.

Gamification: Many AR educational apps incorporate gamification elements, such as rewards, challenges, and competition. These game-like features can significantly boost motivation, making learning more enjoyable.

Positive Learning Experience: Positive learning experiences, which are often associated with AR, can lead to a higher level of intrinsic motivation. Students who enjoy the learning process tend to be more motivated to learn independently.

Comparism Of VR And AR On Students' Motivation and Interest

Virtual Reality (VR) in Education:

Enhanced Engagement: VR provides students with immersive, 3D environments that stimulate their senses and create a sense of presence. This heightened engagement can boost motivation and interest. For example, VR can transport students to historical events, making history come alive.

Personalization: VR allows for personalized learning experiences, catering to different learning styles and paces. As students have control over their learning journey, it can enhance their interest in the subject matter.

Active Participation: Interactive VR activities encourage active learning, as students must physically engage with the virtual environment. This active participation can lead to greater motivation and interest.

Augmented Reality (AR) in Education:

Contextual Learning: AR overlays digital information onto the real world, creating context-rich experiences. This contextualization can make learning more relevant and, thus, increase students' interest.

Hands-On Exploration: AR enables students to explore and interact with virtual objects in their physical environment. For instance, AR apps allow students to dissect virtual animals, fostering hands-on learning experiences that can motivate and interest them.

Collaborative Learning: AR facilitates collaborative learning, as multiple students can interact with the same AR content simultaneously. Collaborative learning can boost motivation and interest through peer engagement.

Comparing VR and AR:

Immersiveness vs Real-World Integration: VR is known for its complete immersion in virtual environments, which can be highly engaging. AR, on the other hand, integrates digital content into the real world, which can be more practical and context-rich.

Resource Intensity: VR often requires expensive hardware and may not be as accessible to all educational institutions. AR, with the prevalence of smartphones and tablets, can be more cost-effective and accessible.

Content Development: Developing VR content can be more resource-intensive than creating AR content. AR apps can often be created more easily, allowing for a wider range of content and applications.

Learning Objectives: The choice between VR and AR should be guided by the specific learning objectives. VR may be more suitable for deep immersive experiences, while AR is well-suited for enhancing real-world context and practical skills.

Both VR and AR have demonstrated their potential to enhance students' motivation and interest in education. VR's immersive environments stimulate

engagement, while AR's contextualization and practicality make learning relevant. The choice between VR and AR should be informed by the specific learning objectives and available resources. As these technologies continue to advance, their impact on student motivation and interest will likely continue to grow, transforming the educational landscape.

Benefits and Limitations Of VR and AR In Science Education

Benefits of VR and AR in Science Education:

Immersive Learning Environments: VR and AR offer immersive, 3D environments that allow students to explore complex scientific concepts. Students can venture inside cells, journey through space, or dissect virtual organisms, creating a deep and lasting understanding of scientific principles.

Interactivity and Engagement: Both VR and AR promote active learning. Students are engaged in hands-on experiences, enabling them to interact with objects, data, and phenomena. This interactivity fosters curiosity and a sense of discovery.

Visualization of Abstract Concepts: VR and AR make it easier to visualize abstract or microscopic concepts that are challenging to comprehend through

traditional methods. For example, students can observe molecular structures, chemical reactions, or geological formations in 3D space.

Remote and Inclusive Learning: VR and AR can bridge geographical and physical barriers. Students can participate in virtual labs and field trips, making science education accessible to a broader audience, including those with physical limitations.

Error-Friendly Environment: Mistakes can be valuable in science education. In VR and AR simulations, students can experiment and make errors without real-world consequences. This encourages critical thinking and problem-solving.

Personalized Learning: These technologies can adapt to individual learning styles and paces. Content can be customized to match students' abilities, ensuring that they are neither overwhelmed nor bored.

Limitations of VR and AR in Science Education:

Cost and Accessibility: High-quality VR and AR hardware and software can be expensive. Schools with limited resources may struggle to implement these technologies, leading to unequal access for students.

Content Development Challenges: Creating VR and AR educational content demands time, expertise, and resources. Teachers may encounter difficulties in finding or developing suitable content for their lessons.

Physical Discomfort: Prolonged use of VR headsets can lead to discomfort, motion sickness, or eye strain, affecting the learning experience. Ensuring ergonomic use and monitoring health concerns is essential.

Technical Glitches: Technical issues can disrupt the learning process. Software glitches, compatibility problems, and network issues can cause frustration and downtime in the classroom.

Learning Curve: Both teachers and students may need time to become proficient in using VR and AR tools effectively. The learning curve can be a barrier to immediate adoption.

Distraction: Overreliance on immersive technologies can lead to distraction and detract from the educational objectives. Striking a balance between immersive experiences and focused learning is essential.

VR and AR hold great promise for revolutionizing science education by enhancing engagement, facilitating visualization, and providing interactive

learning experiences. However, challenges related to cost, content development, and physical discomfort must be addressed to fully harness their potential.

Summary of Reviewed Literature

This literature reviewed explores the impact of virtual reality (VR) and augmented reality (AR) on students' motivation and interest in science education. The integration of immersive technologies into educational settings has gained significant attention in recent years. By synthesizing and analyzing relevant studies, this review provided a comprehensive summary of the existing research on the topic. The findings indicate that VR and AR have the potential to enhance students' motivation and interest in science education by providing immersive and interactive learning experiences. However, the effectiveness of these technologies depends on various factors such as instructional design, content quality, and individual differences among students. Recommendations for future research and implications for science educators are discussed.

CHAPTER THREE

METHODOLOGY

This chapter describes the research methodology that was used in the study under the following sub-headings:

- Design of the Study
- Population of the Study
- Sample and Sampling Technique
- Research Instrument
- Validity of the Instrument
- Reliability of the Instrument
- Method of Data Collection
- Method of Data Analysis

Design of The Study

Survey research method is adopted for the topic, impact of virtual and augmented reality on students' motivation and interest in science education to enable the researcher carry out systematic investigation and obtain information across the population of the study.

Population of the Study

The population of the study comprises of all JSS3 students in government owned schools in Egor local Government area of Edo state.

Sample and Sampling Technique

The sample consists of two hundred (200) JSS3 students who were drawn from 5 (five) junior secondary school students in Egor local Government area of Edo State. The simple random sampling technique was used to select 5 schools from the 12 public junior secondary schools in Egor Local Government Area. 40 students will be randomly selected from each of the schools

Research Instrument

The research instrument is a questionnaire designed by the researcher titled; “impact of virtual and augmented reality on students’ motivation and interest in science education ”. It is divided into two sections: Section A and B. Section A contains particulars of the respondents (demographic data) such as name of school and gender while section B contains twenty items. The

questions contained in the questionnaire revolve round the research questions raised in the chapter one of this study.

Validity of the Instrument

In order to ascertain the validity of the instrument, the questionnaire designed by the researcher would be given to the research supervisor and two other lecturers in the Department of Curriculum and Instructional Technology (CIT) to scrutinize and for necessary corrections. Corrections made on the draft would be incorporated in the final draft.

Reliability of the Instrument

A test re-test reliability method will be used to establish the reliability of instrument. The copies of the questionnaire will be administered to the respondents, after two weeks the same instrument will be re-administered to the same group of students. The data collected after both administrations will be analysed using Pearson Product Correlation Coefficient

Method of Data Collection

The questionnaire will be administered personally by the researcher to the respondent that will be randomly selected from the sample students. The respondent would be assured of confidentiality and urged to answer the questions honestly in the best of their knowledge. Instructions will be given to the respondent on how to fill the questionnaire and the questionnaire would be collected the same day to avoid incident of loss.

Method of Data Analysis

The data collected is properly organized and tabulated. The responses are statistically analysed by the use of simple percentage.

CHAPTER FOUR

PRESENTATION OF RESULT AND DISCUSSION OF FINDINGS

The purpose of this chapter is to report, illustrate and discussed the findings of the research.

Presentation of Results

Table 1: Demographic Data for the Students

SEX	FREQUENCY	PERCENTAGE (%)
FEMALE	12	60
MALE	8	40
TOTAL	20	100%

Source: Researcher's fieldwork, 2023

Answering of Research Questions

Research Question 1: What is the impact of virtual reality on students' motivation and interest in science education?

Table 2: the impact of virtual reality on students' motivation and interest in science education.

S/ N	ITEM	Strongly Agree	Agree	Strongly Disagree	Disagree	TOTAL %
1.	Virtual reality enhances my motivation to learn science	10 (50%)	5 (25%)	2 (10%)	3 (15%)	100
2.	Using virtual reality in science education increases my interest in the subject	6 (30%)	9 (45%)	2 (10%)	3 (15%)	100
3.	Virtual reality makes learning science more engaging and enjoyable for me	8 (40%)	9 (45%)	3 (15%)	Null (%)	100
4.	The use of virtual reality in science classes positively influences my eagerness to participate in lessons	9 (45%)	8 (40%)	1 (5%)	2 (10%)	100
5.	Virtual reality helps me better understand complex scientific concepts	9 (45%)	3 (15%)	6 (30%)	2 (10%)	100

Researcher Fieldwork 2023

Table 2 above shows the impact of virtual reality on students' motivation and interest in science education. 2(10%) and 3(15%) of the

respondents strongly disagreed and disagreed respectively that Virtual reality enhances their motivation to learn science, while 10(50%) and 5(25%) strongly agreed and agreed respectively. On the other hand, 2(10%) and 3(15%) strongly disagreed and disagreed respectively that using virtual reality in science education increases their interest in the subject, but. 6 respondents representing (30%) and 9(45%) strongly agreed and agreed respectively. Seeking opinion of the respondents whether virtual reality makes learning science more engaging and enjoyable for them, 8 of the respondents representing 40% strongly agreed, 9 respondents representing 45% agreed, while 3(15%) and 0(0%) strongly disagreed and disagreed respectively. On the opinion of the use of virtual reality in science classes positively influencing the respondents' eagerness to participate in lessons, 1 of the respondents representing 5% strongly disagreed, 2 respondents representing 10% disagreed, that the use of virtual reality in science classes negatively influencing the respondents' eagerness to participate in lessons while 9(45%) and 8(40%) strongly agreed and agreed respectively

Lastly, 6 respondents representing 30% and 2(10%) disagreed that virtual reality helps them better understand complex scientific concepts, 9(45%) strongly agreed, while 3(15%) agreed.

The study therefore concludes that using virtual reality in learning science increases the interest in the subject and it makes science more engaging and enjoyable.

Research Question 2: What is the impact of augmented reality on students' motivation and interest in science education?

Table 3: Showing the impact of augmented reality on students' motivation and interest in science education.

S/N	ITEM	Strongly Agree	Agree	Strongly Disagree	Disagree	Total %
1.	Using augmented reality in science education improves my understanding of scientific concepts	7 (35%)	5 (25%)	5 (25%)	3 (15%)	100
2.	Augmented reality increases my engagement in science learning activities	6 (30%)	4 (20%)	8 (40%)	2 (10%)	100
3.	I find science lessons more enjoyable when augmented reality is incorporated	4 (20%)	11 (55%)	3 (15%)	2 (10%)	100
4.	Augmented reality positively influences my curiosity about scientific topics	10 (50%)	6 (30%)	2 (10%)	2 (10%)	100
5.	The use of augmented reality in science education improves my overall attitude towards learning science	9 (45%)	7 (35%)	3 (15%)	1 (5%)	100

Researcher Fieldwork 2023

The above Table 3 shows the impact of augmented reality on students' motivation and interest in science education. The responses of 7 of the respondents representing 35% and 5(25%) strongly agreed and agreed that the use of augmented reality in science education increases their understanding of scientific concepts, while 5(25%) and 3(15%) strongly disagree and disagree

respectively. Similarly, 6 respondents representing 30% and 4(20%) agreed that augmented reality increases their engagement in science learning activities, while 8(40%) strongly disagreed, and 20(10%) disagreed. 4 of the respondents representing 20% strongly agreed and 11 representing 55% established that they find science lessons more enjoyable when augmented reality is incorporated, while 3(15%) and 2(10%) strongly disagreed and disagreed respectively. Correspondingly, 10 of the respondent representing 50% strongly agreed and 6 representing 30% agreed that Augmented reality positively influences their curiosity about scientific topics, while 2(10%) and 2(10%) strongly disagreed and disagreed respectively

Finally, the respondents agreed that the use of augmented reality in science education improves their overall attitude towards learning science, with 9 of the respondents representing (45%) strongly agreed, 7(35%) agreed, while 3 of the respondents representing (15%) strongly disagreed and 1(5%) disagreed.

The research from table 4 therefore concludes that the impact of augmented reality on students' motivation and interest positively influences and improves their understanding and attitude towards learning science.

Research Question 3: How do virtual and augmented reality compare in terms of their impact on students’ motivation and interest in science education?

Table 4: Showing the ways in which virtual and augmented reality compare in terms of their impact on students’ motivation and interest in science education.

S/N	ITEM	Strongly Agree	Agree	Strongly Disagree	Disagree	Total %
1.	Virtual reality enhances my motivation to engage with science education	12 (60%)	4 (20%)	3 (15%)	1 (5%)	100
2.	Augmented reality makes learning science more interesting to me	9 (45%)	8 (40%)	1 (5%)	2 (10%)	100
3.	Virtual reality helps me better understand complex scientific concepts	12 (60%)	4 (20%)	1 (5%)	3 (15%)	100
4.	Augmented reality improves my overall interest in studying science	9 (45%)	6 (30%)	3 (15%)	2 (10%)	100
5.	Virtual reality activities make science learning more enjoyable for me	8 (40%)	7 (35%)	3 (15%)	2 (10%)	100

Researcher Fieldwork 2023

The above Table 4 shows response for the ways in which virtual and augmented reality compare in terms of their impact on students’ motivation

and interest in science education. A cursory look at table 4 revealed that 12(60%) and 4(20%) strongly agreed and agreed respectively to the statement that virtual reality enhances students' motivation to engage with science education, while 3 of the respondents representing 15% and 1(5%) strongly disagreed and disagreed respectively. 9 respondents representing 45% and 8(40%) revealed that augmented reality makes learning science more interesting to them, while 1(5%) and 2(10%) strongly disagreed and disagreed respectively. Similarly, the respondents agreed with the statement that virtual reality helps them better understand complex scientific concepts. This was evidenced by the respondents' opinion which showed that 12 of the respondent representing (60%) and 4 representing (20%) strongly agree and agree respectively, while 1(5%) strongly disagreed. 9 respondents representing 45% and 6(30%) bare that augmented reality improves their overall interest in studying science, while 3(15%) and 2(10%) strongly disagreed and disagreed respectively.

Finally, the respondents affirmed that virtual reality activities make science learning more enjoyable for them, as 8 of the respondents representing

(40%) strongly agreed, 7(35%) agreed, while 3 of the respondents representing (15%) strongly disagreed 2(10%) and disagreed.

In the third objective, the study seeks the ways in which virtual and augmented reality compare in terms of their impact on students' motivation and interest in science education.

Based on the result in table 4, the study therefore concludes that virtual and augmented reality enhances motivation to engage in studying science and it makes learning science more interesting.

Research Question 4: What are the potential benefits and limitations of VR and AR into science education?

Table 5: Showing the potential benefits and limitations of VR and AR into science education

S/N	ITEM	Strongly Agree	Agree	Strongly Disagree	Disagree	Total %
1.	VR and AR enhance student engagement in science lessons	7 (35%)	10 (50%)	2 (10%)	1 (5%)	100
2.	VR and AR improve students' understanding of complex scientific concepts	7 (35%)	9 (45%)	1 (5%)	3 (15%)	100
3.	VR and AR increase students' motivation to learn about scientific topics	9 (45%)	6 (30%)	2 (10%)	3 (15%)	100
4.	Integrating VR and AR into science education requires expensive technology and resources	7 (35%)	8 (40%)	2 (10%)	3 (15%)	100
5.	VR and AR might distract students from the actual scientific content by focusing on the technology itself	10 (50%)	4 (20%)	2 (10%)	4 (20%)	100

Researcher Fieldwork 2023

Table 5 shows response for the potential benefits and limitations of VR and AR into science education.

It reveals that 7(35%) and 10(50%) strongly agreed and agreed that VR and AR enhance student engagement in science lessons, while 2 of the respondents representing 10% and 1(5%) strongly disagreed and disagreed

respectively. Similarly, 7 respondents representing 35% and 9(45%) agreed that VR and AR improve students' understanding of complex scientific concepts, 1(5%) strongly disagreed, while 3(15%) disagreed. Similarly, 9 respondents representing 45% and 6(30%) agreed that VR and AR increases students' motivation to learn about scientific topics, 2(10%) strongly disagree, while 3(15%) disagreed. The respondents affirmed that Integrating VR and AR into science education requires expensive technology and resources. This was evidenced by the respondents' opinion which showed that 7 of the respondents representing (35%) and 8 representing (40%) strongly agreed and agreed respectively, while 2(10%) strongly disagreed and 3(15%) disagreed respectively.

Finally, majority of the respondents agreed that VR and AR might distract students from the actual scientific content by focusing on the technology itself, with 10 of the respondents representing (50%) strongly agreed, 4(20%) agreed, while 2 of the respondents representing (10%) strongly disagreed and 4(20%) disagreed.

In the fourth objective, seeking answers on the potential benefits and limitations of integrating VR and AR into science education. Based on the

result in table 5, the study therefore concludes that VR and AR enhances students' participation in science, improves their understanding of scientific concepts and increases their motivation to learn about science, while some limitations of VR and AR are expensive technology and resources, also VR and AR might distract students from the actual scientific content by focusing on the technology itself.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

The purpose of this research was designed to find the impact of virtual and augmented reality on students' motivation and interest in science education. 20 JSS3 students from junior secondary school students in Egor local Government area of Edo state. The researcher made effort in analyzing the conceptual framework, virtual and augmented reality in science education, comparative effectiveness of virtual reality and augmented reality, potential advantages and drawbacks of using technologies in science education. All of which have been discussed in details under the review of literature.

The collection of data was carried out through the administration of questionnaire to twenty (20) JSS3 students from which will be drawn from junior secondary school students in Egor local Government area of Edo state. The data were interpreted and discussed using percentages and frequency table. The sampling technique used for the research is the stratified random.

Conclusion

Following the analysis of the data collected and findings were made:

1. Using virtual reality in learning science increases the interest in the subject and it makes science more engaging and enjoyable.
2. The impact of augmented reality on students' motivation and interest positively influences and improves their understanding and attitude towards learning science.
3. Virtual and augmented reality enhances motivation to engage in studying science and it makes learning science more interesting.
4. VR and AR enhances students' participation in science, improves their understanding of scientific concepts and increases their motivation to learn about science.

Recommendations

Based on the conclusion of the study, the following recommendations are made;

1. Education authorities and institutions should consider integrating VR and AR applications into the science curriculum. This integration

should be accompanied by appropriate training for teachers to effectively utilize these technologies.

2. Schools should invest in the necessary hardware and software infrastructure to support VR and AR in classrooms. Access to the required technology is crucial for widespread implementation.
3. Developers should create high-quality, curriculum-aligned VR and AR content for science education. This content should be diverse, catering to various scientific disciplines and age groups.
4. Ongoing assessment and research are essential to monitor the long-term impact of VR and AR on student motivation and interest in science. Studies should focus on different demographics and educational settings.
5. Teachers should receive training not only in the technical aspects of VR and AR but also in pedagogical strategies for effectively using these technologies to enhance learning.
6. Efforts should be made to ensure equitable access to VR and AR resources, especially in underserved communities, to bridge the digital divide in education.

Suggestion for further studies

This study investigated the impact of virtual and augmented reality on students' motivation and interest in science education, using 20 respondents. The future researcher may repeat this study by using larger population such as more than one local government area.

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