THE USE OF VIRTUAL REALITY IN TEACHING OF BASIC SCIENCE IN SECONDARY SCHOOLS IN ANAMBRA STATE

Christian-Ike, Nwanneka Oluchukwu

no.Christian-Ike@unizik.edu.ng/ ORCID ID: 0009-0004-5639-734x

Nnamdi Azikiwe University, Awka

Okoye, Paschal Olisaeloka

Okoyepaschalo@yahoo.com.08133155301.

Nwafor Orizu College of Education Nsugbe

Abstract

Virtual reality (VR) technology has gained popularity in various fields for its immersive and interactive nature. In recent years, educators in Nigeria have started to explore the use of VR in teaching basic science subject. This paper explores the potential benefits, applications and challenges of using VR technology in the Nigerian education system for the teaching of basic science. The use of VR in teaching basic science in Nigeria has the potential to enhance students' engagement and understanding of complex scientific concepts. By creating realistic and interactive virtual environments, students are able to visualize abstract concepts and conduct virtual experiments, which can lead to a deeper understanding of scientific principles. Additionally, VR can cater to diverse learning styles and provide a more dynamic and interactive learning experience for students. It was recommended that teacher and school administrators could be informed of this, and they should further explain the benefits of VR to parents. Understanding the challenges of using VR in teaching basic science subjects would ultimately provide the means for educational policy makers to suggest the necessary measures to effectively reflect upon the current trends, experiences and practices to support and build capacity for educational change.

Keywords: Virtual Reality, Basic Science, Immersive Experience, Virtual Laboratory and Interactive Environment

Introduction

Science and technology interplay with the society to bring about sustainable development. Nations that are considered to be developed and largely considered as civilized have achieved that status through purposeful scientific education of their citizens. In Nigeria, education is perceived as an instrument for achievement of national objectives (Odili, Ebisine & Ajuar in Chima,2021). According to the National Policy in Education (Federal Republic of Nigeria, 2013), education is an "instrument per excellence" for achievement of national development. This explains the huge amount of money government earmarks for education in its annual budget. To buttress the emphasis on science and technology education in the national policy on Education, Basic Science has been made mandatory as a subject for all Nigerian children at the basic education level.

Basic science formerly known as Integrated Science is the first form of science, a learner comes across at the basic education level. It prepares learners for the study of core science subjects (physics, chemistry and biology) at the senior secondary level and as well tertiary institutions. Basic science as a foundational science encompasses all branches of science, applied science and social sciences in integrated form. It could be defined as a unified science which aims at presenting a holistic view of science concept (Christian-Ike & Okoli, 2021). Basic science is very important in the science curriculum since it enhances the scientific literacy and exposes learners to various scientific process skills. Basic Science concepts are organized into themes in order to avoid duplication of contents and unnecessary repetition of topics in the different science disciplines. It therefore arouses curiosity and develops scientific attitudes and skills in students. This is to help children to develop reflective thinking and good habits which are needed for scientific method and successful future life (Agogo & Ode, 2011). Thus, it is very eminent that its concepts are taught effectively in classrooms using the emerging technologies such as augmented reality, robotics, machine learning, virtual reality among others in education currently in the world today. Despite the relative importance of science and technology to the country's quest for technological advancement, there is a continuous trend of poor implementation of these technologies in basic science curriculum due to inadequate competencies. Thus, there is need to explore these technologies and their usage in basic science teaching. One of these technologies amidst others that had been proven to be effective in science teaching is virtual reality.

Virtual Reality (VR) is a computer-generated simulation of a three-dimensional image or environment that can be interacted with in a highly realistic and immersive way using specialized equipment such as helmet with a built-in

screen or sensor -equipped gloves, creating a sense of presence and interaction in a virtual world. According to Andreas, Christos, Akrivi and Cleo (2023), Virtual reality is an emerging technology that delivers a computer-generated simulation of an environment that may be interacted with in an apparent real-time manner. VR is also defined as a real or simulated environment in which a perceiver experiences telepresence (Minocha, Tudor, & Tilling, 2017). VR is a computer simulation system that can create and simulate virtual words, which provides an immersive experience to the users by generating various types of interactive activities related to visual, auditory and tactile perceptions (Yang et al, 2021). The two different kinds of VR can be identified as non- immersive and immersive (Freina & Ott, 2023). Non – immersive VR is a computer- based environment that simulates places in the real or imagined worlds while immersive gives a further perception of one being physically present in the non-physical world.

VR can be used in industries, agriculture, medicine, entertainment, engineering and education. It is a technology that has been rapidly gaining popularity in the field of education in recent years. Learning in a VR- based simulation environment could be implemented via desktop /laptop PCs or head mounted displays (HMDs) which allowed students to explore complex subjects in a way that traditional/conventional teaching methods cannot (Jiang & Fryer, 2023). In VR, users can explore virtual environments such as games, simulations, or virtual tours. Users can interact with virtual objects, characters, or interfaces. VR tech avails the users an opportunity to engage in immersive experiences like training simulations, playing of games that simulate real world activities. It creates a sense of presence, immersion and blurring the boundaries between the physical and digital worlds.

VR technology has gained increasing attention in the field of science education due to its ability to create immersive and interactive learning experiences. It has a promising tool for transforming teaching and learning experiences especially in science education. In Nigeria, where disparities in access to quality education persist, educational resources and infrastructure often limited, the use and integration of VR in teaching basic science subjects can help bridge gap and offer new opportunities for students to engage with complex concepts provided in a more engaging and effective learning environment.

Various studies in the relevant literature had shown that the use of virtual reality technology in education enhances learning. Mystakidis et al (2021) in their studies showed that students who experienced learning through virtual reality simulations exhibited higher levels of comprehension and problem-solving skills compared to traditional methods. Matovu et al (2022), highlighted the positive impacts of virtual reality in improving students' performance and attitudes towards

science subjects. A study by Ajewole and Oladokun (2019), investigated the impact of a VR based biology lesson on students learning outcomes. Leung et al (2018) analyzed the impact of VR technology on students' engagements and learning outcomes. From these, it indicated that VR technology is one of the modern technologies that have the prowess to enhance learning especially in basic science. Despite the potential benefits, the use and integration of VR in science education faces challenges. This study aims to explore the effectiveness of VR in teaching basic science in Anambra State, its applications and impact on students learning outcomes. By examining the current state of VR and implications, this research seeks to provide insights and recommendations for teachers, curriculum developers and researchers to harness the potential of VR in enhancing basic science teaching.

This study specifically sought to:

1. Explore the various applications of VR in science teaching
2. Highlight some basic science concepts that can be taught using VR
3. Examine the benefits of virtual reality in basic science education.
4. Outline challenges facing the use of virtual reality in basic science education.
5. Explore the implications of virtual reality in basic science education

Application of Virtual reality in Basic Science Teaching

Virtual reality has numerous applications in science teaching and could be applied too in basic science. These includes;

1. Interactive simulations: VR allows students to participate in virtual laboratory, experiments, simulations and making complex concepts more engaging and accessible.
2. Virtual field trips: Students can explore virtual environments, such as historical sites, museums, or distant planets, enhancing their learning experience.
3. 3D Visualization: VR enables students to visualize complex structures, molecules, and cells in 3D, improving their understanding of abstract concepts.
4. Interactive models: Students can manipulate virtual models of scientific phenomena, like climate change or population dynamics, to analyze and predict outcomes.
5. Immersive experiences: VR can recreate historical scientific events or experiments, allowing students to step into the shoes of scientists and experience the scientific process firsthand.
6. Gamification: VR games can teach scientific concepts, especially in basic

science in an engaging and entertaining way. This will enable the students to actively participate in basic science activities.

7. Virtual Dissections: Students can conduct virtual dissections, exploring human anatomy in a detailed and interactive manner.
8. Data analysis: VR can facilitate interactive data visualization and analysis, enabling students to explore and understand complex data sets.
9. Collaborative learning: VR enables basic science students to collaborate on virtual projects, fostering teamwork and communication skills.
10. Accessibility: VR can provide equal access to scientific experiences for students with disabilities or limitations in basic science teaching.

Basic Science Concepts That Can Be Taught Using Virtual Reality (VR):

Basic science as a grassroot for all core science subjects encompasses the integrated concepts of biology, physics and chemistry in its curriculum. It is divided into themes which are “you and the environment",” living and non- living things', “you and technology”, and “you and energy” (Chima, 2021) to enable the students have a better understanding of the concepts in the themes. Some of these concepts are sometimes seems to be difficult to understood when not taught with the appropriate instructional aids. As such VR as a more advanced technology will help the students for a better understanding. Some of these concepts includes:

1. Cell structure and function: VR can take students on a journey inside a cell, exploring organelles and their functions.
2. Human body systems: VR can simulate the circulatory, respiratory, and digestive systems, helping students understand how they work.
3. Plant growth and reproduction: VR can demonstrate the life cycle of plants, from seed germination to flower formation.
4. Ecosystems and conservation: VR can transport students to different ecosystems, teaching them about food chains, habitats, and conservation.
5. Simple machines and mechanisms: VR have interactive simulations of levers, pulleys, and gears, making physics more engaging.
6. Chemistry lab experiments: VR can simulate chemical reactions, allowing students to conduct experiments safely and interactively.
7. Physics experiments: VR can recreate classic physics experiments, such as Newton's laws and electricity, in a virtual lab setting.
8. Human skeletal and muscular systems: VR can provide an interactive 3D exploration of the human body's bones and muscles.
9. Weather and climate: VR can simulate different weather conditions and

climate zones, teaching students about meteorology and environmental science.

10. Basic biology concepts: VR can teach concepts like mitosis, meiosis, and DNA structure in an interactive and immersive way.

Challenges associated with the use Virtual Reality in teaching Basic Science:

There are various challenges associated in teaching basic science with Virtual Reality Technology. These include;

1. Cost: High-quality VR equipment and software can be expensive, making it inaccessible to some schools and students.
2. Technical issues: Using VR technology in teaching requires specialized equipment such as V headsets and controllers, as well as powerful computers to run the software. These gadgets can be prone to technical glitches, hardware malfunctions, and software compatibility issues.
3. Limited instructional design: The availability of educational VR content may be limited, and development costs can be high. Its educational content can be time-consuming and expensive. There are also lack of standardized content available, making it difficult for educators/teachers to find suitable resources for their teaching. For example, teachers stated that currently, VR does not provide suitable learning materials in accordance with local syllabus and context.
4. Lack of adequate research: There is still a limited amount of research on the effectiveness of using virtual reality in science education, making it difficult for educators to assess its impact on student learning outcomes (Ab Kadir, 2017).
5. Social isolation: VR experiences can be isolating, potentially reducing social interaction and collaboration among students.
6. Lack of focused attention and time management: VR can be distracting, leading students to focus on the technology rather than the learning content. this could consume a lot of time and might not enable the teacher finish their syllable.the students when they are not focusing on a learning task for a continuous period could be exhausting to the teacher. VR may distract students, particularly when they explore a virtual world and chat with other students simultaneously (Boellstorff ,2015)
7. Equity and access: Not all students have equal access to VR technology, potentially exacerbating existing educational inequalities.
8. Lack of competency: This refers to the lack of VR functionalities to ensure the competency of students. A suitable platform may not be available for

accommodating the learning requirements of different students. For example, it is assumed that VR is more suitable for computer literate students, matured or self-initiated learners, and upper primary students. The majority of teachers agreed that immature students may not find it interesting. Educators may need training to effectively integrate VR into their teaching practices.

9. Assessment challenges: Evaluating student learning and understanding in VR environments can be difficult.
10. Health concerns: Prolong use of VR technology can lead to issues eye strain (Park et al., 2017), motion sickness, mental discomfort, physical inactivity, and mental well-being. Teachers and students need to be mindful of these potential risks and implement strategies to mitigate them.

The Implications and Recommendations

This study showed that VR have several applications and common challenges. The educational decision makers may need to consider the shared aspects of VR to effectively utilize them in schools. In addition, basic science teachers may attempt to encourage parents to allow their children to bring their own devices to school for learning. If parents resist educational technology, students would have lesser exposure to VR. School administrators could also be informed of this, and they could further explain the benefits of VR to parents. Understanding the challenges of using VR in teaching basic science subjects would ultimately provide the means for educational policy makers to suggest the necessary measures to effectively reflect upon the current trends, experiences and practices to support and build capacity for educational change. This study offers suggestive evidence for the lack of practice among teachers to master VR technology. It indirectly reflects that teachers must be updated and trained on various educational technology practices especially VR. It further implies that state education departments, district education offices, and schools should offer more related courses to refine teachers' VR skills and knowledge. Information on technology should be disseminated in a manner that could benefit teachers and students. In addition, the lack of guidelines in VR, lack of instructional design, lack of competency, and lack of focused attention in VR can lead us to understand that VR instructional and application designs are the most important factors for ensuring their usability in the education system. Severe monitoring must be performed to ensure that this is carried out correctly. This study is of the view that VR could be implemented in an effective manner. However, the digital divide between urban and rural school students might increase. Thus, the ministry may consider supporting rural school students by bridging this gap. The study appears to offer new evidence on the role of VR in promoting students'

engagement and exploratory behavior towards science teaching. Since the use of VR has been introduced to in the current teaching of anatomy and physiology at some universities, there is an additional benefit to students if basic science teachers can take on this technology. This may help and imitate the styles of learning in high schools and tertiary institutions in the future.

Conclusion

The use of virtual reality technology in teaching Basic science subject in Anambra State has the potential to revolutionize science education and improve students' learning outcomes. By creating immersive and interactive learning experiences, VR can enhance student engagement and understanding of scientific and understanding of scientific concepts. VR technology can help bridge the gap in access to quality science education and empower students to excel in sciences. Continued research and collaboration among educators, policymakers and technology providers are essential to harnessing the full potential of VR in science education in Anambra State. This study discussed how virtual reality technologies can benefit students' learning by developing a positive attitude among teachers, thus promoting technology utilization in the classroom. It provides access to virtual labs and field trips, expanding learning opportunities. It personalizes and provides interactive learning experiences. Insights from this study might provide the administrators and policy makers to set priorities for using VR to carry out various reflective practices and exploration tasks in basic science teaching. However, there are few concerns regarding this technology reported in terms of lack of functionalities for supporting students' competency, which may not provide a suitable platform for accommodating different abilities. The limited learning materials offered in these environments may not necessarily suit students' learning goals in accordance with the standard local syllabus. In addition, students can be distracted when engaging in a learning activity with limited monitoring.Overreliance on technology, potentially diminishing practical skills and potential for misinformation and misconceptions if content is inaccurate

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