TEACHERS' ATTITUDE TOWARD THE INTEGRATION OF VIRTUAL REALITY FOR TEACHING BIOLOGY CONCEPTS IN SENIOR SECONDARY SCHOOLS IN KWARA STATE, NIGERIA

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Abstract

Biology concepts such as photosynthesis, respiration, enzyme activity, sex-linked traits, genes, nervous system, hormones, among others, are perceived as abstract and seem difficult for teachers and students in senior schools. Therefore, the study examined teachers' attitude towards virtual reality and the perceived usefulness of virtual reality for teaching Biology. The study population comprised all senior secondary Biology teachers in Kwara State. Purposively, 263 Senior Secondary Biology teachers in Ilorin metropolis were sampled. The data was analysed using frequency count, mean, and t-test. The result showed that: Biology teachers have positive attitudes toward the integration of virtual reality for teaching (3.00); teachers perceived the usefulness of virtual reality for teaching Biology (2.92); there was no significant difference between male and female Biology teachers' attitude towards virtual reality for teaching; and there was a significant difference between male and female Biology teachers' perceived usefulness of virtual reality for teaching $(0.069 < 0.05)$. The study highlights the need for continuous teacher training to sustain VR integration in Biology classrooms. Based on the findings of the study, the study recommends that teachers should endeavour to improve the use of virtual reality for teaching difficult biology concepts.

Keywords:

Introduction

Science is a field of knowledge that has been instrumental to the development of nations. Biology is one of the natural science disciplines at secondary schools in Nigeria. Objectives of the Biology curriculum in Nigeria are to prepare students to acquire adequate laboratory and field skills in Biology, meaningful and relevant knowledge of Biology, the ability to apply scientific knowledge to everyday life in matters of personal, community health, agriculture, and a reasonable and functional scientific attitude. The use of appropriate instructional materials to aid the teaching of Biology concepts to the learner is essential. Teaching Biology can be supported with technology tools. Educators are fast realising that the use of computer-assisted instruction for learning (Ebrahimi, 2016). The advancements in mobile and image-processing technologies have enabled students to access learning resources and receive learning guidance in virtual world contexts (Hwang et al., 2017).

One of the advancements of technology in education, where students can receive learning in a virtual world context, is virtual reality. Virtual reality is a computer-simulated, game-based learning environment which appears real and gives learners the opportunity to interact with the learning materials and share learning experiences with teachers and other learners (Onele, 2020). Virtual reality is a computer-generated, three-dimensional, multimedia environment. In virtual reality, participants can engage and manipulate simulated physical elements in the environment and interact with fictional or simulated components (Onele, 2020). Virtual reality is also known as immersive visualisation, which is a 3D interpretation environment. A 3D interpretation environment is an artificial virtual environment produced by computers. Virtual reality allows users to enter and experience a digital environment in real-time so that it will feel as if they are in that environment (Astuti et al., 2019).

VR allows learners to acquire knowledge and skills outside the four walls of the classroom without really feeling the gap of not being in the conventional classroom system (Soetan et al., 2020). VR is an important technology tool which can be used in different levels of education and various domains to assist students in learning and building knowledge in innovative and more attractive ways (Astuti et al., 2019). Studies have shown that virtual reality technology can be used for teaching. A study was conducted by Akgün and Atici (2022). The study found that immersive virtual reality environments had a positive, moderate effect on students' academic performance. Virtual reality can be used by the teacher to teach Biology in the classroom as a teaching material.

It was observed in the studies of Etobro and Fabinu (2017); Chukwuemeka and Dorgu (2019); and Haruna, (2021) that photosynthesis, respiration, enzyme activity, dominance and codominance, sex-linkages, genes and chromosomes, mitosis and meiosis, nervous system, hormones, Mendelian genetics, nutrient cycling in nature, ecological management, conservation of natural resources, pests, diseases of crops and reproductive system in plants are concepts in Biology that are perceived as difficult by teachers and students in senior secondary school. Also, these concepts are regarded as an abstract level in biology in the curriculum. As a result, students will lack the required knowledge and skills in learning Biology. Danso (2016) explained that the difficult topics in Biology were characterised by complex terms and vocabulary; the abstract nature of the topics, the broad nature of the topics; teachers not conducting practical laboratory work but teaching theoretically and a lack of teaching/learning resources, and teachers' failure to cite practical examples students can relate with. Integration of innovative technology tools like virtual reality into the teaching process might address difficult concepts in Biology.

In order to assure integration of VR, teachers' attitude towards integrating VR as an educational tool for teaching the Biology concept is imperative. A key determinant of the success of any educational initiative is the teacher (Junaidu, 2019). Attitudes refer to an intangible reality that manifests itself through people's thoughts, acts, beliefs, or words. These are the elements that guide people's behaviour and actions, the result of the emotional (feelings) and cognitive (thoughts) analysis they make of reality (Guillén-Gámez et al., 2020). Kumar and Ratnakar (2016) noted that attitudes allude to the subjective response of the individual (with positive or negative polarity) concerning the valuation of some object or belief.

Teacher perception is another factor to be considered for the integration of virtual reality. Perception is the way humans perceive something, which includes human senses, human experiences, and human reactions to the environment (Putra et al., 2020). Perception is a feeling taken after experience through the interpretation of a stimulus recorded in the brain by more than one sense organ (Ajijola et al., 2021). From the above, perception can therefore be the way humans understand the knowledge and represent it from their point of view.

Furthermore, gender is an important factor that can influence teachers' attitude and perception towards the integration of technology for teaching. The term gender refers to a wide range of biological, behavioural, physical and mental characteristics regarding differentiate the female and the male population (Adigun et al., 2015). Anaza (2017) noted that gender differences in the use of technology should be carefully examined, rather than merely demonstrating differences. The influence of gender in classroom utilisation of technology also plays a major role in the selection, development and performance of instructional objectives (Soetan et al., 2020). Despite the proven educational potential of VR, little is known about Biology teachers' attitudes toward its integration in Kwara State.

Empirical studies on teachers' attitude toward virtual reality show that teachers have' positive attitude towards using virtual reality for teaching (Regine & Reynato, 2022; Abdunabievich, 2020). Studies conducted on teachers' perception of virtual reality revealed that teachers' perception of virtual reality was very positive (Putra et al., 2020; Wells & Miller, 2020). On gender and technology adoption, Emeka (2015) study found that there was no effect of gender on lecturers' perception of the utilisation of modern technology. Abdullahi (2020) reported that gender does not influence the adoption of virtual laboratories

for teaching among physics teachers. Similarly, Soetan et al. (2020) established that there was no significant difference between male and female teachers' awareness of virtual reality for instructional purposes. However, few empirical studies have examined teachers' attitudes toward VR integration in Nigerian secondary schools, particularly in Biology, creating a gap that this study seeks to fill. Therefore, this study investigated teachers' attitude towards virtual reality for teaching Biology in Kwara State.

Purpose of the Study

The main purpose of the study was to find out teachers' attitude towards virtual reality for teaching Biology. Specifically, the study:

1. Determined the teachers' attitude toward the integration of virtual reality for teaching Biology.

2. Examined teachers' perceived usefulness of virtual reality for teaching Biology.

Research Questions

Based on the purposes raised above, the following research questions were raised and answered in this study.

1. What is the teachers' attitude toward the integration of virtual reality for teaching Biology?

2. What are the teachers' perceived usefulness of virtual reality for teaching Biology?

Research Hypotheses

The following null hypotheses were formulated and tested in this study at the 0.005 level of significance;

$H0_1$: There is no significant difference in Biology teachers' attitude toward virtual reality for teaching biology concepts based on gender

$H0_2$: There is no significant difference between male and female Biology teachers' attitude towards virtual reality for teaching.

Methodology

The study adopted a descriptive research design of a survey type. The population for this study comprised all senior secondary Biology teachers in Kwara State. The target population were all Senior Secondary Biology teachers in Ilorin metropolis. Purposively, the study sampled Biology teachers in Ilorin. A census sampling technique was used to sample 263 Senior Secondary Biology teachers in this study. Researcher-designed questionnaire titled "Senior Secondary School Teachers' Attitudes towards the Integration of Virtual Reality for Teaching Biology Concepts in Kwara State" was used to elicit information from the respondents on the integration of virtual reality for teaching Biology Concepts. The instrument is divided into three sections, A, B & C. Section A focuses on demographic data of the respondents, and sections B-C elicit information on the teachers' attitudes towards the integration of virtual reality for teaching biology concepts in Kwara State.

The instrument was validated by three Educational Technology experts to determine the face and content validity of the instrument being used for this study. In order to determine the internal consistency of the questionnaire, the instrument was pilot-tested on Biology teachers in another local government, which is not part of the study sample population. The data obtained from the pilot test to determine the reliability of the instrument test was subjected to Cronbach's alpha to determine the internal consistency of the questionnaire. The result yielded a 0.88 coefficient of reliability.

The researcher proceeded to the secondary schools with an introductory letter soliciting the permission of all appropriate authorities of the sampled schools. The researcher personally administered the questionnaire to the Biology teachers in the sample secondary schools with the help of a research assistant. During the process of this research, ethical issues were considered, and respondents were permitted to participate in the study voluntarily without being coerced. Information gathered during this study was handled with utmost confidentiality so that when reporting the findings of the participants' identities would not be disclosed. The researcher ensured that all cited works are referenced and acknowledged to avoid plagiarism. The data was analysed based on the stated research questions and hypotheses, using frequency count, mean, and an independent sample t-test.

Results

Research Question 1: What is biology teachers' attitude toward the integration of virtual reality for teaching?

Table 1: Biology Teachers' Attitude Toward the Integration of Virtual Reality for Teaching

Items	Mean
1. I like the idea of integrating virtual reality for teaching Biology concepts	3.01
2. I like the way virtual reality presents objects in 3D, which makes more easier to observe objects from different angles	2.69
3. 3D objects in virtual reality make it easy to teach abstract concepts	3.31
4. I prefer teaching Biology concepts using virtual reality	2.97
5. Virtual reality is suitable for teaching all Biology concepts	3.30
6. Virtual reality makes object viewing a virtual world seem real	2.99
7. I feel that teaching with virtual reality has helped abstract concepts in Biology	3.27
8. I feel virtual reality will help me improve my digital skills	3.03
9. I prefer virtual reality to other instructional materials	2.48
10. I find the operational interface of virtual reality not difficult	2.88
Grand mean	**3.00**

To determine the Biology teachers' attitudes toward the integration of virtual reality for teaching, as stated in research question 1, and as shown in Table 1. The mean score for each of the question items is listed in the last column of the table. The average mean score for each of the items is 2.50. The average mean score of 2.50 was calculated by adding up each value of the 4-point Likert scale and divided by 4 (Strongly Agree = 4, Agree = 3, Disagree = 2, and Strongly Disagree = 1. 4+3+2+1=10 divided by 4 = 2.50. Item 3 has the highest mean score of 3.31, which is greater than the average mean score (2.50), and item 9 has the lowest mean score of 2.48, which is less than the average mean score (2.50). The grand mean of the entire item is 3.00, which is greater than the 2.50 average mean score. This implies that Biology teachers have positive attitudes toward the integration of virtual reality for teaching.

Research Question 2: What is teachers' perceived usefulness of virtual reality for teaching?

Table 2: Biology Teachers' Perceived Usefulness of Virtual Reality for Teaching

Items	Mean
1. Using virtual reality in teaching Biology would enable me to break the barrier of abstract concepts	3.31
2. Using virtual reality would improve my teaching performance	3.15
3. As a teacher, using virtual reality for instruction would increase my productivity	3.22
4. Using virtual reality would enhance my teaching	3.04
5. Using virtual reality would make it easier to teach abstract concepts in Biology	3.18

6. I feel that using virtual reality for teaching will be beneficial to my teaching experience	2.51
7. I am comfortable using a virtual reality tool for teaching Biology in the classroom.	2.64
8. Virtual reality is very useful for displaying video content	2.86
9. Virtual reality is very effective for teaching Biology	2.63
10. Through virtual reality, students focus their senses on the teaching topic	2.75
Grand mean	**2.92**

To examine how teachers perceived the usefulness of virtual reality for teachingBiology, as stated in research question 2, and as shown in Table 2. The mean score for each of the question items is listed in the last column of the table. The average mean score for each of the items is 2.50. The average mean score of 2.50 was calculated by adding up each value of the 4-point Likert scale and divided by 4 (Strongly Agree = 4, Agree = 3, Disagree = 2, and Strongly Disagree = 1. 4+3+2+1=10 divided by 4 = 2.50. Item 1 has the highest mean score of 3.31, which is greater than the average mean score (2.50) and item 6 has the lowest mean score of 2.51, which is also greater than the average mean score (2.50). The grand mean of the entire item is 2.92, which is greater than the 2.50 average mean score. This implies that Biology teachers perceived the usefulness of virtual reality for teaching Biology concepts.

Hypothesis Testing

H_{O1}: There is no significant difference between male and female Biology teachers' attitude towards virtual reality for teaching.

Table 3: Independent Sample t-test showing a significant difference in Biology teachers' attitude toward virtual reality for teaching biology concepts based on gender

Gender	N	X	SD	df	T	Sig. (2-tailed)	Decision
1. Male	89	45.61	5.72				
				261	-1.288	.199	Not Rejected
2. Female	174	45.04	6.64				

From Table 3, it can be deduced that there is no significant difference between male and female Biology teachers' attitude towards virtual reality for teaching. This is reflected in the result: t (261) = -1.288, p > 0.05. That is, the result of the t-value of -1.288, resulting in a 0.199 significance value, which is less than the 0.05 alpha value. Thus, the null hypothesis is rejected. This implies that there was no significant difference between male and female Biology teachers' attitude towards virtual reality for teaching

H_{O2}: There is no significant difference between male and female Biology teachers' perceived usefulness of virtual reality for teachingBiology concepts

Table 4: Independent Sample t-test showing a significant difference between male and female Biology teachers' perceived usefulness of virtual reality for teaching Biology concepts.

Gender	N	X	SD	Df	T	Sig. (2-tailed)	Decision
1. Male	89	45.91	6.55				
				261	-1.826	.069	Rejected
2. Female	174	44.14	6.35				

From Table 4, it can be deduced that there was no significant difference between male and female Biology teachers' perceived usefulness of virtual reality for teaching Biology concepts based on gender. This is reflected in the result: t (261) = -1.826, p < 0.05. That is, the result of the t-value of -1.826, resulting in a 0.069 significance value, which is less than the 0.05 alpha value. Thus, the null hypothesis is rejected. This implies that there was no significant difference between male and female Biology teachers' perceived usefulness of virtual reality for teaching.

Discussions

The result of this study shows that Biology teachers have positive attitudes toward the integration of virtual reality for teaching. This study aligns with the Chao et al. (2019) study on educational use of spherical video-based virtual reality: A preliminary study from the teacher perspective. The study findings revealed that teachers showed positive attitudes towards using virtual reality for teaching after attending a training course. The result of the study supports the findings of Yildirim et al. (2020) on using virtual reality in the classroom: Reflections of STEM teachers on the use of teaching and learning tools. Teachers have positive attitudes towards using virtual reality for teaching, as it captures student interest, increases creativity, and improves understanding of difficult concepts.

Findings from the study revealed that Biology teachers perceived the usefulness of virtual reality for teaching Biology concepts. The result disagreed with Wells and Miller (2020), that the teachers held opinions about VR technology intertwined with a considerable degree of uncertainty about the technology and its uses. But the study agreed with the Alfalah et al (2017) study on perception toward adopting virtual reality as a learning tool in information technology. The results showed that the end users are willing to adopt VR systems as a teaching tool. Also, the finding conforms with Khukalenko et al (2022) study on teachers' perceptions of using virtual reality technology in classrooms. The study showed that teachers had moderately positive perceptions toward the use of VR for instruction.

Furthermore, several studies have investigated the sociodemographic factors on teachers' concerns about the integration of new technologies in education. Gender differences were investigated. The findings of this study indicated that there was no significant difference between male and female Biology teachers' attitude towards virtual reality for teaching. The result of this study is in line with Kirneva (2022) study, which revealed that male and female school teachers have equally favourable attitudes towards technology integration, indicating significant gender-based differences. The research conducted by Rabten (2024) on analysing teachers' attitude towards integrating technology in teaching and learning revealed that attitude of female and male school teachers towards using technology in teaching do not differ significantly from each other. The findings support the result of this study that no significant difference between male and female Biology teachers' attitude towards virtual reality for teaching.

The result showed that there was a significant difference between male and female teachers' perceived usefulness of virtual reality for teaching Biology concepts. The findings align with the findings of Antón-Sancho et al. (2022) on the perspective of science professors' didactic use of virtual reality in Colombian Universities. The study found that there are differences in perceptions of virtual reality's usefulness for teaching between male and female university professors in Colombia. This research implies that for teachers to integrate virtual reality for teaching, teacher professional development, ICT policy, and classroom practice.

The implications of findings in the study are significant for the professional development of teachers and ICT policy. The relatively high levels of attitudes of the Biology teachers in regards to the integration of virtual reality to teach in the classroom demonstrate the necessity of the specific professional developmental programs that will provide the teachers with the skills and confidence to use VR technology successfully. This may be training on VR integration, classroom management, and pedagogy. The ICT policy must focus on the supply of VR resources, infrastructure, and technical assistance to schools, which would allow fair

access to the given technology. Teachers can use VR in the classroom to facilitate immersive learning in the classroom and attract the interest of the students, enhance creativity, as well as enhance learning of complicated topics. Using the power of VR, teachers can improve the quality of education and improve the learning outcomes of the students.

Conclusion

Based on the findings the study concluded that teachers have positive attitudes toward the integration of virtual reality for teaching Biology; teachers perceived the usefulness of virtual reality for teaching Biology concepts; there was no significant difference between male and female teachers' attitude towards virtual reality for teaching Biology; and there was a significant difference between male and female teachers' perceived usefulness of virtual reality for teaching Biology.

Recommendations

Based on the result of this study, the study recommends that:

1. Biology teachers should develop a positive attitude toward integrating virtual reality for teaching Biology concepts

2. Biology teachers should have a positive perception on integrating technology tools like virtual reality for teaching Biology concepts at secondary school to improve students' learning outcomes in the subject

3. Biology teachers, both male and female, should develop more interest in using virtual reality for teaching.

4. Future studies may explore experimental validation of VR-assisted Biology teaching to assess its impact on student learning outcomes

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