

EFFECTS OF VIRTUAL REALITY-BASED INSTRUCTION ON CHEMISTRY STUDENTS' PERFORMANCE AND RETENTION IN COLLEGES OF EDUCATION IN NORTH-EAST, NIGERIA

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Abstract

The study investigated the effects of virtual reality-based instruction on Chemistry students' performance and retention in colleges of education in north-east, Nigeria. The study was guided by two objectives while research questions and hypotheses were formulated in line with the objectives. Quasi-experimental design was used in carrying out the study. The population of study was all the nine hundred and fifty three (953) N.C.E II Chemistry students of colleges of education in north-east, Nigeria. One hundred and eighty four (184) were sampled using purposive sampling technique. Chemistry Performance and Retention Test (CPRT) was used as instrument for data collection. The reliability index of 0.8 was obtained using Pearson Product Moment Correlation Coefficient (PPMC). Mean and standard deviations were used to answer the research questions, while paired sample t-test and independent t-test were used to test the null hypotheses formulated for the study. The study established that, students taught Chemistry using virtual reality-based instruction performed significantly better in post-test than those taught using conventional instruction ($P\text{-value } 0.000 < 0.05$). No significant difference exist between the post test and post-post-test performances of students taught Chemistry using virtual reality-based instruction in colleges of education in north-east, Nigeria ($P\text{-value } 0.513 > 0.05$). It was concluded that, virtual reality-based instruction is more effective in enhancing student's performance and retention than the conventional method. Based on the findings, it was recommended that, government should provide colleges of education with viable and functional computer laboratories and high internet coverage so as to aid virtual reality-based learning of Chemistry, as it was found to be effective in enhancing students' performance.

Keywords: Virtual Reality-Based Instruction, Chemistry, Performance, Retention.

Introduction

The evolution of technology has permitted the use of new approaches in the teaching and learning process. Education software benefits the learning process and makes it more interesting for students. The school or learning environment must be conducive for learning to be effective, in other word, conducive learning environment assist students in their academics and pave ways to learn. The large class size and overpopulation in most tertiary institutions in

Nigeria have increase the possibilities of mass failure and made some students to lose interest in school. This is because overcrowded classroom does not allow individual students to get the attention from the teacher, which always leads to low reading scores, frustration and poor academic performance (Egbo, 2014). Increased enrollments rates have created challenges in most schools in Nigeria in ensuring quality education and satisfactory learning achievement. In this vain therefore, it would be meaningful to integrate and innovate newer strategies, techniques and materials leading to the better performance and understanding.

Virtual reality-based is an online classroom that allows an individual to participate in live classroom without traveling to any other place. It is done with the convenience of technological gadgets such as smart phones, desktop, laptop and so, on which have internet connection that is facilitated through specialize video conferencing applications. In this learning environment, the teacher and the students will be in position to interact with one another, communicate, ask questions, participate in laboratory exercise, view and discuss the lecture contents presented through internet connectivity as if the action is taking place in traditional classroom setting but it is done virtually (Salihu, 2021).

This classroom setting requires both the teacher and the students to log in to the virtual reality learning environment simultaneously with their technological gadgets. Virtual classroom can be used to upload word files, audios and videos. The system provides a dashboard available to the users where they can view the files uploaded by the course instructor and access these files from any electronic device including computers and mobiles. Teachers can also upload recorded lectures for those students who have missed the class due to some unavoidable circumstances such as accident or sickness. Teachers can use virtual classrooms to conduct online exams, different sets of questions from different chapters or lessons can be stored in the database. After completion of a lesson, students can sit for online exams, which are automatically graded by the system. Students can also get immediate feedback from the course instructor regarding their exams. Virtual classroom could be seen as the classrooms capable of replacing partially or totally the conventional educational, evaluative and administrative functioning of a regular classroom by adopting the advanced technologies like the internet, e-mail, on-line chatting, teleconferencing and video conferencing (Anekwe, 2017).

Virtual classroom refers to courses offered through the internet. It is a teaching and learning environment located within a computer mediated communication system which consists of a set of group communication and work spaces and facilities that can surpass that of the traditional classroom, a process in which students and instructors are actively involved in creating and carrying out learning activities together like group discussion, joint projects, and debates, sharing of solutions to problems by emails, bulletin boards, chat rooms and conferences (Sufeng & Runjuan, 2013).

Chemistry is one of the science subjects taught at Senior Secondary School level of Nigerian education system. It's a prerequisite subject for the study of engineering, medicine, other basic and applied science courses in any tertiary institution. In Colleges of Education, chemistry is taken either as a single or combined course for the award Nigeria Certificate in Education. It deals with the understanding of how students learn Chemistry, how best to teach Chemistry,

and how to improve learning outcomes by changing teaching methods and appropriate training of Chemistry instructors. According to Njoku (2009),

Academic performance is the outcome of education. It refers to what students achieve in their studies and how they cope with or accomplish different learning experiences given to them by their teachers (Umar, 2019). Retention is the ability to store learned concepts, which can easily be recalled from the short and long-term memory (Egbo, 2014). The purpose of education is to learn and learning involves acquiring knowledge which should be retained. It is based on the stated background that the researcher intended to find out the effects of virtual reality instruction on Chemistry students' performance and retention in colleges of education in north-east, Nigeria.

Statement of the Problem

Poor students' performance and retention in Chemistry at tertiary level of education in general and colleges of education in particular is alarming and has been a matter of concern by education deliverers and many other stake holders. These problems could be attributed to the following factors, overcrowding of lecture halls, poor and inadequate infrastructure, poor teaching methods, insecurity and pandemics among others. In this vain therefore, it would be meaningful to innovate newer strategies leading to the better performance and retention of sciences in general and Chemistry in particular (Anekwe, 2017).

Objectives of the Study

The objectives were to:

1. ascertain the difference between post-test performance of Chemistry students taught using virtual reality-based instruction and those taught with conventional instruction in colleges of education in north-east, Nigeria.
2. determine the differences between the post-test and post-post-test performances Chemistry students taught using virtual reality-based instruction in colleges of education in north-east, Nigeria.

Research Questions

The following research questions were raised to guide the study.

1. What is the difference between the post-test performance of Chemistry students taught using virtual reality-based and those taught with conventional instruction in colleges of education in north-east, Nigeria?
2. What is the difference between the post-test and post-post-test performances of Chemistry students taught using virtual reality-based instruction in colleges of education in north-east, Nigeria?

Hypotheses

Based on the research questions, the following hypotheses were formulated:

- HO₁. There is no significant difference between the post-test performance of Chemistry students taught using virtual reality-based instruction and those taught with conventional instruction in colleges of education in north-east, Nigeria.

HO₂. There is no significant difference between the post-test and post-post-test performance of Chemistry students taught using virtual reality-based instruction in colleges of education in north-east, Nigeria?

Methodology

The study adopted Quasi-experimental design, specifically; pre-test, post-test and post-post-test design was used with one experimental group and one control group. The population of the study comprised of nine hundred and fifty three (953) NCE II Chemistry education students from the ten colleges of education offering Chemistry in north-east Nigeria. The sample size for the study comprised of one hundred and eighty four (184) NCE II Chemistry education students from the intact classes of the sampled colleges of education. A purposive sampling technique was adopted in selecting the two colleges of education in north-east, Nigeria.

The instrument used for data collection in this study was Chemistry Performance and Retention Test, tagged (CPRT). CPRT contains fifty (50) objective questions with four (4) multiple-choice items options A-D each. On the scoring of the multiple choice items, two (2) marks were awarded for each correct answer and zero (0) mark for each wrong answer. The instrument was scored over 100 (2x50 items). The instrument was validated by experts from the department of Educational Foundations and Curriculum, Faculty of Education, Ahmadu Bello University Zaria and one expert from Chemistry Education department, Federal College of Education Zaria. Test-retest method was used in testing the instrument for the reliability coefficient. The data obtained from the pilot test was analyzed using Pearson Product Moment Correlation Coefficient (PPMCC) through Statistical Package for Social Sciences. The reliability index of 0.8 was obtained.

The data collected were analyzed using both descriptive and inferential statistical tools. Mean and standard deviation were used to answer the research questions, while hypotheses one was analyzed using paired sample t-test and hypothesis two was analyzed using independent t-test.

Results

Research Question One: What is the difference between the post-test performance of Chemistry students taught using virtual reality-based instruction and those taught with conventional instruction in colleges of education in north-east, Nigeria?

Table 1: Mean and standard deviation of the post-test performance of students taught Chemistry using virtual reality-based instruction and those taught using conventional instruction in colleges of education in north-east, Nigeria

Post-test	N	Mean	SD	Mean Differences
Experimental	102	60.41	15.475	
Control group	82	42.73	9.698	17.68

Table 1 showed the summary of mean and standard deviation of the post-test performance of students taught Chemistry using virtual reality-based instruction and those taught using conventional instruction in colleges of education in north-east, Nigeria. The table showed that the students taught using virtual reality-based had a mean score of 60.41 and standard deviation of 15.475 while the mean scores and standard deviation of students taught using conventional

instruction were 42.73 and 9.698 respectively. Their mean difference was 17.68. This showed that, the students taught Chemistry using virtual reality-based instruction performed better than those taught using conventional instruction in colleges of education in north-east, Nigeria.

Research Question Two: What is the difference between the post-test and post-post-test performances of Chemistry students taught using virtual reality-based instruction in colleges of education in north-east, Nigeria?

Table 2: Mean and standard deviation of post-test and post-post-test performance of students taught Chemistry using virtual reality-based instruction in colleges of education in north-east, Nigeria

Variable	N	Mean	SD	Mean Differences
Post test	102	60.41	15.475	0.12
Post-post test	102	60.53	15.141	

Table 2 indicated the summary of mean and standard deviation of post-test and post-post-test performance of students taught Chemistry using virtual reality-based instruction in colleges of education in north-east, Nigeria. The mean score of post-test was 60.41 and standard deviation of 15.475, while the post-post-test had the mean score of 60.53 and standard deviation of 15.141. The mean difference was 0.12. This result indicated that, the students taught Chemistry using virtual-based had better performance in their post-post-test This implied that, virtual reality-based instruction improve students retention ability in Chemistry.

Hypothesis One: There is no significant difference between the post-test performance of Chemistry students taught using virtual reality-based instruction and those taught with conventional instruction in colleges of education in north-east, Nigeria.

Table 3: Summary of independent sample t-test on the post-test performance of students taught Chemistry using virtual reality based instruction and those taught using convention instruction in colleges of education in north-east, Nigeria.

Post test	N	Mean	SD	t-cal	Df	A	t-crit	p-value	Decision
Control	82	42.73	9.698	9.926	182	0.05	1.96	.000	Rejected
Experimental 1	102	60.41	15.475						

Table 3, showed the results of the independent sample t-test on the post-test performance of students taught Chemistry using virtual reality based instruction and those taught using convention instruction in colleges of education in north-east, Nigeria. The result revealed that, the t-cal of 9.926 was greater than the t-crit 1.96 at df 182 and p-value .000 was less than the alpha value of 0.05 level of significance, which indicates that the difference between the post-test performances of students taught Chemistry using virtual reality-based instruction and those taught using conventional instruction is statistically significant. Hence, the null hypothesis that said there is no significant difference between the post-test performance of Chemistry students

taught using virtual reality-based instruction and those taught with conventional instruction in colleges of education in north-east, Nigeria, was rejected.

Hypothesis Two: There is no significant difference between the post-test and post-post-test performances of Chemistry students taught using virtual reality-based instruction in colleges of education in north-east, Nigeria.

Table 4: Summary of paired sample t-test on the post test and post-post-test performance of students taught Chemistry using virtual reality-based instruction in colleges of education in north-east, Nigeria.

Test	N	Mean	SD	t-cal	Df	A	t-crit	p-value	Decision
Post Test	102	60.41	15.475	2.451	202	0.05	1.96	.106	Retained
Post-post Test	102	60.53	15.141						

Table 4 showed the summary of paired sample t-test on the post test and post-post-test performance of students taught Chemistry using virtual reality-based instruction in colleges of education in north-east, Nigeria. The results revealed t-cal of 2.451 was greater than t-crit 1.96 at df of 101, while p-value of 0.106 was greater than 0.05 levels of significance, which indicates that the difference that existed between the post test and post-post-test performances of students taught Chemistry using virtual reality-based instruction was not significant. Hence, the null hypothesis that said there is no significant difference between the post-test and post-post-test performances of Chemistry students taught using virtual reality-based instruction in colleges of education in north-east, Nigeria, was retained.

Discussion of Findings

Findings of the study revealed that, the chemistry students exposed to virtual reality-based instruction performed significantly better than those exposed to conventional instruction. This finding showed that experimental strategy (virtual reality-based) is effective in enhancing students’ performance in chemistry. This finding is in line with the findings of Salihu (2021), which revealed that, virtual reality instruction has positive effect in fostering conceptual performance and interest among the students. The finding also complemented the findings in the study carried out by Rasouli (2021), on the effects of virtual reality based teaching on students learning performance in anatomy among medical students of Razi medical school in Kermanshah. Their findings revealed that, the students exposed to virtual reality had a significant academic achievement, which showed that, virtual reality has positive effects on learning achievement of students.

Conclusion

Based on the findings of the study, it was concluded that, the use of virtual reality-based instructional strategy had the potentials of improving and enhancing students’ performance and retention. Therefore, employing this strategy for teaching of chemistry will go a long way in improving the quality of teaching and learning of chemistry in schools.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Government should provide colleges of education with viable and functional computer laboratories and high internet coverage so as to aid virtual reality-based learning of Chemistry, since it was found to be effective in enhancing student's performance.
2. Seminars and workshops should be organized by the college managements to train Chemistry lecturers on the use virtual reality-based instruction.

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