

EFFECT OF INTERACTIVE ICT-BASED APPROACHES ON STUDENTS ACADEMIC PERFORMANCE AND RETENTION AMONG BIOLOGY STUDENTS OF SENIOR SECONDARY SCHOOLS, KATSINA STATE, NIGERIA

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Abstract

The study investigated the Effect of interactive ICT-Based Approaches on Students Academic Performance, Retention among Biology Students in Senior Secondary Schools in Katsina State, Nigeria. Three objectives, three research questions and three hypotheses were formulated to guide the study. One of the objectives is to; find the difference between pretest and posttest academic performance of students taught with interactive ICT-based approaches among Biology students of senior secondary schools in Katsina State, among others. The study was conducted using quasi experimental research design consisting pretest, posttest and post posttest non randomized nonequivalent groups. The population of the study comprised 15,400 students from 12 schools in Katsina Zonal Quality Assurance. The sample of this study comprised 100 SS 2 students from two intact classes. The research questions raised were answered using mean and standard deviation while hypotheses were tested using paired sample and independent t-test at 0.05 Alpha level of significance. The findings of the study revealed that; the use of Interactive ICT-based approaches has a significant effect on student academic performance and retention in Biology. The study concluded that: significant difference existed between the mean score of the students taught Biology using Interactive ICT-based approaches and those taught with conventional teaching method in favour of experimental group. The study recommended that Federal and States Ministries of Education should ensure proper integration of Interactive ICT-based approaches in teaching Biology

Key Words: Interactive ICT-Based Approaches, Performance, Retention, and Biology

Introduction

Science Education is the bedrock of civilization and development of any nation, without it no nation can move from where it is to the next level, Nigeria has made various efforts towards the realization of education (Tafi, 2016). Teaching, most especially science-related courses such as biology sometimes requires the presentation of the utilization of concrete Interactive ICT-based approaches that could approve the senses of seeing and hearing. These Interactive ICT-based approaches brought a lot more that can be used in teaching biology as a science subject, taught in senior secondary schools (Umar, 2021). The knowledge of biology is not only paramount and useful to the teacher and learners, but to everyone who seeks to go with the changing trends of society through the utilization of Interactive ICT-based approaches (Ezeh, Awa, Okoye, Emecheta, & Anazodo, 2020). Knowledge

is power and education is indeed fundamental to the development of a dynamic labour force capable of accessing and integrating knowledge into social and economic activities and participating in today's global economy. The use of ICT has made teaching easier, more concrete, real, and more result-oriented (Etiubon & Akpan, 2020).

The main goals of ICT integration into education, particularly in secondary education, are to improve the quality and value of secondary education and expand access to education (NPE, 2024). Learning through the use of ICT allows students to choose when and where to progress in their learning, choose content, be free to use the appropriate media, and study anywhere anytime. The fact that ICT plays a vital role in modern teaching and learning cannot be overemphasized. (Kingsley & Otabor, 2019).

Academic performance refers to achievement of individuals' objective to various types of knowledge and skills. According to the author the objectives are established based on the age, prior learning and capacity of individuals with regards to education, socialization, and qualification.

Students' performances in recent times give cause for alarm and school authorities more than the students themselves are being accused of lack of dedication, declining productivity and even mindlessness. Nevertheless, the students have not been doing well, and the situation is not improving. Retention is the ability to retain and consequently remember things experienced or learned by an individual later, retention can be described as a form of reaction to what has been presented in the past. When concepts are taught, the wish of the teacher is that the concepts taught should be remembered. Retention has been defined as the ability to remember things (Abdullahi 2018). Retention of concepts learnt would help in reflective thinking and the use of the retained concepts can be used in creative ways to solve novel problem.

In Katsina State, like many parts of Nigeria, Biology instruction in senior secondary schools often relies heavily on traditional lecture-based methods, chalk-and-talk delivery, and limited laboratory access. These factors can hinder students' comprehension, engagement, and performance. This research investigates whether the systematic use of Interactive ICT-based approaches can improve academic outcomes by boosting students' performance in Biology, enhancing retention of the material, and increasing motivation and interest in the subject

Poor academic performance is taken in this study to mean low scholastic achievement that falls short of expectation. Student performance in the West Africa Examination Certificate (WAEC, 2025) has revealed that many students are underperforming Frequent incidence of leakages and examination malpractices on the part of the examination bodies may not be entirely unconnected with lack of dedication on the part of teachers, inadequate teaching materials, supervision, qualified staff, exponential enrolment, automatic promotion, low funding of education on the part of government, low level of commitment of students and inadequate provision, broken homes, emphasis on materialism on the part of parents, and incapability on the part of principals. Some parents and other stakeholders in secondary education have argued that private schools have a more positive attitude towards intellectual development of students and therefore offer higher learning opportunities to their students' performance in academics. On the contrary, it is felt that governments (owners of public schools) provide little or no intellectual and motivational environment for their students, which in turn has an adverse effect on the students' academic performance.

The problem has persisted and it has been an issue of concern to the researcher, students, teachers, school administrators and community in general. Therefore, this study is intended to determine the Effect of interactive ICT-based approaches on Students Academic Performance, Retention among Biology students of Senior Secondary School in Katsina State, Nigeria.

Objectives

The following are the objectives of this study:

1. to find the difference between pretest and posttest academic performance of students taught with interactive ICT-based approaches among Biology students of senior secondary schools in Katsina State,
2. to examine the difference between posttest mean scores of students taught with interactive ICT-based approaches and those with conventional teaching method among Biology students of senior secondary schools in Katsina State,
3. to determine the difference on retention ability between the students taught with interactive ICT-based approaches and those taught with conventional teaching method among Biology students of senior secondary schools in Katsina State,

Research Questions

The following research questions were formulated based on the objectives:

1. What is the difference between pretest and posttest performance of students taught with interactive ICT-based approaches among Biology students of senior secondary schools in Katsina State?
2. What is the difference between posttest mean scores of students taught with Interactive ICT-based approaches and those taught with conventional teaching methods among Biology students of senior secondary schools in Katsina State?
3. What is the difference on retention ability between the students taught with Interactive ICT-based approaches and those taught with conventional teaching method using Interactive ICT-based approaches among Biology students of senior secondary schools in Katsina State?

Hypotheses

H₀₁: There is no significant difference between pretest and posttest performance of students taught with interactive ICT-based approaches among Biology students of senior secondary schools in Katsina State?

H₀₂: There is no significant difference between posttest mean scores of the students taught with Interactive ICT-based approaches and those taught with conventional teaching method among Biology students of senior secondary schools in Katsina State.

H₀₃: There is no significant difference on retention ability between the students taught with Interactive ICT-based approaches and those taught with conventional teaching method among Biology students of senior secondary schools in Katsina State.

Methodology

Quasi experimental research design using pretest, posttest and post-posttest was adopted as research design. Two schools (experimental group and one for control group) were used for the study.

The population of the study comprised; fifteen thousand four hundred (15400) students, covered 12 public senior secondary schools offering Biology in Katsina metropolis.

Purposive sampling technique was used in selecting schools that formed the sample due to availability of ICT facilities in the Schools. The sample size of one hundred (100) students were assigned to experimental and control groups. Two intact classes (one from experimental group and one from control group) were used for the study.

The instrument used for data collection is ICT Biology Performance Retention Test (IBPRMT) developed by the researchers comprised 20 test items.

Three Biology and ICT experts validated the instruments and all their suggestions were accepted. Pilot test was conducted with a group of 20 students in Katsina College Katsina, a Senior Secondary School that did not form the study sample.

Test re-test method was used to determine the reliability of the instrument using Pearson Product Moment Correlation (PPMC) and 0.71 was obtained,

The treatment lasted for the period of five weeks to collect data using ICT Biology Performance Retention Test (IBPRT) instrument was administered to the two groups at pretest, after the treatment both groups (experimental and control) were given posttest, in order to determine whether there is significant difference between the two groups, and also Student Motivation Questionnaire” (SMQ) was administered. After two weeks without notice to the students post posttest was administered to determine the retention ability of the students.

The data collected was subjected to analysis at two different levels, the research questions was answered by using mean and standard deviation. However, analysis of research hypotheses involved analysis using t-test independent sample at 0.05 alpha level of significance using data of post-test academic performance scores of students in experimental and control groups.

Answering Research Questions

Research Question one: What is the difference between pretest and posttest performance of students taught with interactive ICT-based approaches among Biology students of senior secondary schools in Katsina State?

Table 1 Mean and Standard Deviation of Pretest and Posttest Performance of Experimental Groups

Variable	N	Mean	S. D	Mean diff
Pretest	35	11.24	1.02	
Posttest	35	25.82	1.749	14.52

Table 1 shows descriptive statistics of the differences that existed between academic performances of students taught Biology using interactive ICT-based approaches before and after treatment in Secondary Schools in Katsina State. The academic performance of students taught Biology before using interactive ICT-based approaches was 11.24 with standard deviation of 1.02, it increased to 25.82 and standard deviation of 1.749, after treatment with a mean difference of 14.52 between the two groups, in favor of after the exposure to the interactive ICT-based approaches. This implies that the intervention of interactive ICT-based approaches has had effect on their academic performance of students taught Biology.

Research Question Two: What is the difference between posttest mean scores of students taught with Interactive ICT-based approaches and those taught with conventional teaching method among Biology students of senior secondary schools in Katsina state?

Table 2 Mean and Standard Deviation of Academic Performance of Experimental and Control Groups

Groups	N	Mean	S. D	Mean diff
Experimental	35	25.82	1.749	9.622
Control	65	16.20	2.619	

Table 2 shows descriptive mean and standard deviations statistics of students' taught Biology using Interactive ICT-based approaches and those taught with conventional teaching method among Biology students of senior secondary schools in Katsina State. The academic performance of students taught Biology in the experimental group has the mean of 25.82 and standard deviation of 1.749, while the control group has the mean of 16.20 and standard deviation of 2.619 with a mean difference of 9.622 between the two groups favor of experimental group. This implies that the intervention of interactive ICT-based approaches has had effect on their academic performance of students taught Biology than conventional teaching methods

Research Question Three: What is the difference on retention ability between the students taught with Interactive ICT-based approaches and those taught with conventional teaching method among Biology students of senior secondary schools in Katsina State?

Table 3 Mean and Standard Deviation of Retention Ability of Experimental and Control Groups

Group	N	Mean	S. Deviation	Mean diff.
Experimental	35	25.822	1.749	10.482
Control	65	15.340	3.000	

Table 3 shows descriptive mean and standard deviations of statistical difference that existed between retention ability of students Biology concepts using Interactive ICT-based approaches and those taught using conventional teaching methods in Katsina State. The Retention ability of students Biology concepts using Interactive ICT-based approaches and those taught Conventional teaching methods were is 25. 822 and standard deviation of 7.748, while compared with the mean of conventional teaching method with the mean of 15.340 and standard deviation of 3.000 on student's retention ability in favour of those students taught using Interactive ICT-based approaches. This implies that the retention ability of students taught Biology concepts using Interactive ICT-based approaches is higher than those taught using conventional teaching methods.

Hypotheses

H₀₁: There is no significant difference between pretest and posttest performance of students taught with interactive ICT-based approaches among Biology students of senior secondary schools in Katsina State?

Table 4: Paired sample t-test of Difference between Pretest and Posttest Performance of Students Taught with Interactive ICT-Based Approaches

Variables	N	Mean	SD	Mean dif.	df	t	P
Pretest	35	11.24	1.02	14.58	34	3.17	0.000
Post Test	35	25.82	1.74				

P = 0.000, t computed = 3.17 > 1.96 at df 34

Table 4 shows that; the t- value obtained is 3.17, df is 34 and p-value of 0.000. The p-value (0.000) is less than the alpha level which is 0.05, as such the null hypothesis which states there is no significant difference in the mean score of the students taught with Interactive ICT-based approaches and those taught with conventional teaching method among Biology students of senior secondary schools in Katsina State is rejected. This signifies that there is significant difference in academic performance between experimental and control in favor of experiment group. The students taught using information communication technology (ICT) performed better than those taught using conventional teaching method.

H₀₂: There is no significant difference between posttest mean score of the students taught with Interactive ICT-based approaches and those taught with conventional teaching method among Biology students of senior secondary schools in Katsina State.

Table 5: Independent t-test Analysis of Students Academic Performance between Experimental and Control Groups

Variables	N	Mean	SD	Mean dif.	df	t	P
Experimental	35	25.82	1.749	9.622	99	20.818	0.007
Control	55	16.20	2.619				

P = 0.007, t computed = 20.818 > 1.96 at df 99

Table 5 shows that; the t- value obtained is 20.818, df is 99 and p-value of 0.007. The p-value (0.007) is less than the alpha level which is 0.05, as such the null hypothesis which states there is no significant difference in the mean score of the students taught with Interactive ICT-based approaches and those taught with conventional teaching method among Biology students of senior secondary schools in Katsina state is rejected. This signifies that there is significant difference in academic performance between experimental and control in favor of experiment group. The students taught using information communication technology (ICT) performed better than those taught using conventional teaching methods.

H₀₃: There is no significant difference on retention ability between the students exposed to Interactive ICT-based approaches and those taught with conventional teaching method among Biology students of senior secondary schools in Katsina state.

Table 6 Independent t-test Analysis of Retention Ability of Experimental and Control Groups

Variables	N	Mean	SD	Mean dif.	df	t	P
Experimental	35	25.822	1.749	10.482	99	20.502	0.000
Control	55	15.340	3.00				

P = 0.000, t computed = 20.502 > 1.96 at df 99

Table 6 shows that; the t-value obtained is 20.502, df is 99 and p-value of .000. Therefore, p-value is

less than the alpha level which is 0.005. As such the null hypothesis which states that there is no significant difference on retention ability between the students exposed to Interactive ICT-based approaches and those taught with conventional teaching method among Biology students of senior secondary schools in Katsina state is rejected. This signifies that Interactive ICT-based approaches have significant impact on students' retention ability. Therefore, information communication technology improves retention.

Discussion

The finding from the analysis of the research question and hypothesis number one shows that; Significant differences existed between academic performances of students taught Biology concepts using Interactive ICT-based approaches before and after treatment in favour of after treatment in senior secondary schools in Katsina State.(Mean Dif is 14.58, t- value obtained is 3.17, df is 34 and p-value of 0.000) This shows that the treatment given is effective and when maintained very good performance on students in Biology would be maintained and Interactive ICT-based approaches should be used as a means of improving students' performance in the subject. This finding is in conformity with that of Okwuduba (2018), reported that computer should be employed in chemistry teaching as a means of improving students' achievement in the subject and providing a real life experiment for dangerous chemistry practical's, this is also in conformity with the findings of Lanre (2021), It also concluded that the effectiveness of each of the treatment was not dependent on academic ability and finally that each treatment was effective in improving students' performance. Mammam and Garba (2019), recommended that teachers should be trained on development and utilization of multimedia facility in their teaching through seminar, workshop and conference; Teachers should be encourage to adopt the use of appropriate multimedia facilities that will arouse student's interest.

The finding from the analysis of the research question and hypothesis number two shows that: significant difference in academic performance between experimental and control in favor of experiment group. (Mean diff. 9.622, t- value obtained is 20.818, df is 99 and p-value of 0.007. The p-value (0.007). This shows that students taught using information communication technology ICT performed better than those taught using conventional teaching method. This was in line with the finding of Abdullahi (2018), Awoniyi and Kamanga (2016); and Wallace, John, & Oada, 2019) research findings which revealed that students taught using ICT performed better than their counter part taught using convectional lecture teaching method.

The finding from the analysis of the research question and hypothesis number three shows that: significant effect on students' retention ability existed in favour of control group. (Mean Diff. 10.482, t-value 20.502, df is 99 and p-value of .000). This shows that the retention ability of students taught using information communication technology ICT is higher than those taught using conventional teaching method Therefore, information communication technology improves retention. This finding was in line with Abdullahi (2018) which revealed that students taught using Interactive ICT-based approaches are more retentive than their counter part taught using conventional teaching method. The finding is also in consonant with that of (Wallace, John, & Oada, 2019) who recommended the use of ICT for teaching Chemistry in colleges of education. Therefore, Interactive ICT-based approaches influence students' retention ability in Biology.

Conclusion

From the findings of the study, the following conclusions were made:

1. There is significant difference between pretest and posttest scores of the students taught Biology using Interactive ICT-based approaches, in favour of experimental group.

2. There is significant difference in the mean score of the students taught Biology using Interactive ICT-based approaches and those taught with conventional teaching method, in favour of experimental group.
3. There is significant difference in retention ability between the students taught with Interactive ICT-based approaches and those taught with conventional teaching methods, in favour of experimental group.

Recommendations

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

1. Federal and States Ministries of Education through Zonal Education Quality Assurance offices should ensure proper use of Interactive ICT-based approaches and also teachers should be encourage to use the approach as this research finding revealed that this approach is much better than the conventional teaching methods.
2. Teachers should use Interactive ICT-based approaches as a pedagogical means of helping students toward improving their performance and retention abilities, since Interactive ICT-based approaches have a great impact on students' performance and retention.
3. Professional Associations like the Science Teachers Association of Nigeria (STAN) should popularize the effective use of Interactive ICT-based approaches in teaching Biology concepts through seminars, work-shops, conferences and publications.

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