EFFECT OF COMPUTER-SIMULATION-INSTRUCTION ON PERFORMANCE IN ECOSYSTEM AMONG SECONDARY SCHOOL BIOLOGY STUDENTS OF VARIED ABILITY LEVEL IN KADUNA NORTH, NIGERIA

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Abstract

This study investigated the effect of computer simulation instructional strategy on performance and retention in ecosystem among secondary school Biology students of varied ability levels in Kaduna North Local Government Area, Kaduna Nigeria. SS II Biology students constituted the target population (14951) out of which 195 students were selected as sample for the study through simple random sampling technique. The study adopted pretest, posttest and post -posttest quasi-experimental control group designs. Two groups were formed: The Experimental and the Control group. The experimental group students were taught ecosystem concept using Computer Simulation Instructional Strategy while the control group students were taught the same concepts using lecture method. The instrument used for data collection was Ecosystem Performance Test (EPT). The instrument was validated. The Reliability coefficient of EPT was 0.85. test-retest method was used to determine the reliability coefficient of EPT. Based on the objectives, the study was guided by four research questions and four null hypotheses. The research questions were answered using descriptive statistics while the null hypotheses stated were tested at p - 0.05 level of significance using Analysis of Variance (ANOVA). at p- value. The result showed that varied ability students in the experimental group performed significantly better than those in control group in both academic performance and retention ability. Based on the findings of this study, it was recommended among others that Biology teachers in senior secondary schools should adopt computer simulation instruction strategy in teaching difficult concepts like ecosystem.

Introduction

Science is a system of acquiring knowledge based on scientific process. The improvement of science literacy among citizen is a tool for economy, social and individual development in any country. It has been reported by NCCE (2023), that the Federal Government of Nigeria emphasized the introduction of science subject in Nigeria. This is to enable citizens acquire the knowledge of their environment, develop problem solving skills, desirable scientific attitude, as well as increase their understanding of the role and functions of science in everyday life. Chinwe and Chukelu, (2011) stated that science is a great enterprise which nation depend on in order to advance technologically. According to National Policy on Education (2013), the study of science is of great importance, a lot of emphasis has been laid on the teaching and learning of science as contained in the national policy on education to equip the students to live effectively in this modern age. Hence the need for science education is vital for the development of any nation.

Science education is a field that is concern with the sharing of science contents and processes with individuals who are not considered traditionally to be part of the scientific community and these learners may be children, college student, market women or adult within the general public (kola, 2018). Science education can also be seen as the process of transferring scientific skills, scientific process, scientific method, ability and competencies both mental and physically to live and contribute to the development of the society (Kola, 2018). Oludipe (2012), reported student's low academic achievement among Nigerian public school student it was a source of concern to parents, teachers, science educators, examination bodies and general public in Nigeria . Lakpini (2012), posited that the poor performance in science is attributed to so many factors such has poor teaching methods, improper use of instructional materials, constant use of lecture method and students' poor understanding of basic concept in science. Science as a course has many branches such as Biology, chemistry, physics and agricultural science.

Biology as a course of study in Nigeria Senior Secondary School curriculum. According to Umar (2013), Biology is a natural science that deals with living world, how the world is structured, how it functions and what these functions are, how it develops, how living things came in to existence, and how to react to one with their environment. Umar (2013), stated that areas of biology like medicine, pharmacy, horticulture, biotechnology biochemistry and microbiology are all derived from the knowledge of Biology. Abimbola (2016) and Ibrahim (2016), showed that biology is a branch of science that involve the study of living things, it is a fascinating study that ranges microscopic cellular molecules to the biosphere encompassing the earth surface and it's living organisms. Biology as a subject

when properly taught will help to solve personal and societal problems. Oyarole, (2017), and WAEC (2021), stated that despite the importance of biology as a subject, students still perform poorly in the subject, especially in the area of ecosystem.

The problem associated with the teaching of biology at Senior Secondary School level in Nigeria, according to James (2013) and Ibrahim (2016) are attitude of teachers towards teaching of biology, learning style, motivation, use of instructional material, teaching method in which conventional lecture method is used most. James, (2013) further explained that good academic performance happens when proper teaching methods are been maintained by the teachers or instructors in the process of teaching and learning of biology. Olorukooba, (2012), supported the fact that the teaching and learning of science in Nigeria requires more than the traditional and chalk talk (lecture method) being practiced in schools by teachers, that most teachers do not adopt instructional techniques and strategies that could stimulate creative thinking skills. Adeyemi, (2012), commented that the conventional method is characterized by emphasis on instructor behaviour rather than students' behaviour, minimal responses of students to the instructional materials and delayed feedback on students' performance. Ibrahim, (2016), stated that many research has been carried out to explain the causes of the poor performance, the desire to know the causes of the poor performance in biology has been the focus of researchers for some time now and it has been observed that poor academic performance in biology may be caused by the poor quality of biology teachers, overcrowded classrooms and inadequate instructional material and so on. West and Graham (2021), Computer simulation instruction can help in solving such problem by carrying all the student along and it can also help in motivating

student and once student are motivated it will be easy for teachers to achieve his/her objective effectively or help teachers reach their full potential and the teacher will not have problem with class control irrespective of the class size.

Abdullahi (2012), Baillie and Mesly (2015) narrated that simulation serves as a guide, as well as provide an avenue for conducting activities for the students, so that they can be able to build and modify their existing mental models that can help to improve performance. In line with this study, the use of simulation instruction would make the students motivated to make their own personal construction of knowledge through interaction between the individual knowledge scheme and experiences with the environment.

Simulation is one of the educational tools that fosters long-term learning by calling attention to objects during the early steps of instruction demonstrated that using simulation to communicate ideas and processes that change over time reduces the abstractions associated with the temporal transitions of the process (Bedau, 2011). According to Abdullahi (2012), identified the different types of simulations. These are; procedural, physical, *equation-based* and *agent-based simulation.* Baillie and Mesly, (2015) further stated that, simulations of both types are used for three different general sorts of purposes (those that teach about something and those that teach how to do something). Simulations that teach how to do something are classified either as procedural or situational simulations, those that teach about something are classified either as physical or process simulations. Therefore, physical simulations was used for this study because it present a physical object or phenomenon on the computer screen, giving the students an opportunity to learn about it and provide learners with the observations and experiences that they must attempt to explain, assimilate and

combine with their existing knowledge. Baillie (2015) opined that the impact of computers simulation on performance of students has shown that visual perception is the most developed sense in humans and is an important way by which we learn, vision allows us to collect and process information from our environment and to make decisions or form concepts from that information. Mayer (2012) opined that visualization aids student understanding of complex processes, because it assists in the conversion of an abstract concept into a specific visual object that can be mentally manipulated. Therefore the researcher is going to present an object on the computer screen for the student to learn about it and what they see at that moment may last longer in their memory since there's a strong connection between the eyes and the brain.

Lakpini (2012), stated that in a normal class room situation students differs in the ability levels and this ability students is also an important factor in enhancing the teaching and learning of Biology and neglecting of this ability student may be one of the major causes of poor academic performance. According to Ibrahim (2015) ability leaners is the grouping of students into different ability groups (high, average and low) based on their performance in a given test. Lakpini (2012) mentioned that grouping students based on their achievers level may be done at random or in some systematic ways. Ability grouping is usually done by placing students with basically similar cognitive ability in the same group. Lakpini (2012) pointed out that the grouping was determine as follow, High ability level are the upper 25%, Medium abilty level are the middle 50%, while the low achievers level are the bottom 25%, the grouping ware based on students performance on Biology Performance Test. According to Ofonime (2010), there are students' with different academic ability levels which are categorized as low, medium and high

ability level. Student with marks from 0% to 39% are low level ability, those with 40% to 69% are middle level ability and those with 70% and above are high level ability Ofonime [2010],also described the low level academic students as academic potentials are judged below class average while their achievement is described as poor. Lakpini (2012) stressed that the high level ability students are those who academic potentials are above class average and their achievements described as good. Studies by Ahmed (2010), Bitrus (2012), Bunkure (2012) and Lakpini (2012) all revealed that students of high ability levels achieved higher than the medium and low ability achievers in the experimental group when compared with their counterpart in the control group. The poor performance of students may be due to poor teaching method and lack of proper instructional strategies, therefore the researcher decide to use computer simulation method which is more of entertainment to improve the performance and retention of the varied ability students in Biology in Kaduna North Local Government.

Research Questions
1. What is the difference between the mean academic performance scores of students with ability level taught ecosystem using CSI and those taught using lecture method?
2. What is the difference between the mean academic performance scores of male and female students with varied abilities taught ecosystem concept using CSI?

Null Hypotheses
Based on the research questions, the following null hypotheses were formulated and tested at $P \leq 0.05$ level of significance.
1. **H01**: There is no significant difference between the mean academic performance scores of students with varied ability taught ecosystem using CSI and those taught using lecture method.
2. **H02:** There is no significant difference between the mean academic performance of male and female students of varied ability taught ecosystem concept using CSI

Research Design
This study employed quasi-experimental control group design involving pre-test, post-test and post post-test control group design. The statistics from the State Ministry of Education showed that the total number of schools are seventeen (17) with a population of twelve thousand five hundred and fifty-eight (12,558) student. SS II Biology students constituted the target population out of which 195 students were selected as sample for the study through simple random sampling technique using draw from the hart method

Table 3.2: Sample Schools for the Study

S/N	Group	High	Average	Low	Total
1	Experimental	30	45	25	100
2	Control	30	45	20	95

Source: Researchers' Field Work (2019)

The instrument used for the purpose of this study is Ecosystem Performance Test (EPT). The Ecosystem Performance Test (EPT) consists of two sections, A and B. Section A seeks personal information of respondents in terms of gender, class, name/location of schools and age, while section B consists of 50 multiple choice objective questions adapted from past Senior School Certificate Examination (SSCE) question papers. The test items cover the entire topic unit and was used in determining the performance of students prior and after treatment. Each of the 50 multiple choice items have four options, one correct answer and three plausible distractors.

Result And Interpretation

The data obtained from the experimental and control groups were used in answering the research questions and testing the hypotheses. The research questions were answered using descriptive statistics such as mean and standard deviation while Two-way ANOVA was used to test the hypotheses at p- 0.05 level of significant

To answer question one, a descriptive statistic of mean and standard deviation was used. The detail of the result is presented in Table 4.1.1

Table 4.1.1: Mean and Standard Deviation of Students of The Experimental and The Control Groups.

Ability Level	Group	N	Mean	Std. Dev.	Mean Diff
High	Experimental	28	51.40	1.60	
					18.20
	Control	25	33.20	2.20	
Average	Experimental	41	46.70	0.80	
					18.40
	Control	41	28.30	5.90	
Low	Experimental	23	43.70	1.10	
					17.50
	Control	19	26.20	5.30	

The table shows that differences exist between the means of experimental and control group ($p < 0.05$).

Table 4.1.2: Two-way Analysis of Variance (ANOVA) of the Mean Scores of Experimental and Control Groups

Source	Type III Sum of Squares	Df	Mean Square	F	P-value	R
Corrected Model	14260.817[a]	5	2852.16	229.69	0.01	S
Intercept	262327.98	1	262327.98	21125.96	0.01	S
Groups	7612.33	1	7612.33	613.04	0.01	S
Ability	3137.06	2	1568.53	126.32	0.01	S
Groups * Ability	2677.72	2	1338.86	107.82	0.01	S
Error	2123.36	171	12.42			
Total	301668.00	177				
Corrected Total	16384.18	176				

Significant at P ≤ 0.05

To answer question two, a descriptive statistic of mean and standard deviation was used. The detail of the result is presented in Table 4.2.1

Table 4.2.1: Mean & Standard Deviation of Male and Female in Experimental Group

Ability Level	N	Gender	Mean	Std. Deviation	Mean Diff.
	10	Male	48.40	1.60	
High					0.20
	18	Female	48.20	1.62	
	11	Male	44.50	0.50	
Average					0.10
	30	Female	44.60	0.80	
	9	Male	40.70	0.5	
Low					0.20
	14	Female	40.90	0.5	

This shows that the performance mean scores of male and female students exposed to CSIS are similar ($p>0.05$)

Table 4.2.2:   Two-way Analysis of Variance (ANOVA) of the Mean Scores of Male and Female Students with Varied Ability in the Experimental Group

Source	Type III Sum of Squares	Df	Mean Square	F	P-value	R
Corrected Model	9.991[a]	5	1.998	1.751	0.13	*NS
Intercept	171332.20	1	171332.20	150155.31	0.01	*S
Ability	9.43	2	4.72	4.134	0.02	*S
Gender	0.11	1	.11	.095	0.76	*NS
Gender * Ability	.15	2	0.08	.067	0.94	*NS
Error	98.13	86	1.14			
Total	202491.00	92				
Corrected Total	108.120	91				

*S= Significant at P ≤ 0.05
*NS= Not Significant at P ≤ 0.05

Hypothesis Testing
H01: There is no significant difference between the mean academic performance scores of students with varied ability taught ecosystem using CSI and those taught using lecture method.

Hypothesis 1: Result from Table 4.1.2 showed that significant difference exists between the mean performance scores of Biology students of varied abilities levels taught with Computer Simulation Instruction (CSI) and their counterparts taught with lecture method. Reasons being that the intercept P-value of 0.01 is less than P≤ 0.05 level of significance in both experimental and control group. Therefore,

the null hypothesis which states that there is no significant difference between the mean performance scores of students with varied ability taught ecosystem using Computer Simulation Instruction (CSI) and those taught using lecture method is hereby rejected (Table 4.1.2). This implies that there is significant difference between the performance of varied ability level students exposed to Computer Simulation Instruction (CSI) and those exposed to lecture method.

Hypothesis 2: Result from Table 4.2.2 showed that there is no significant difference in the mean scores of Male and Female students of varied abilities levels

taught with Computer Simulation Instruction (CSI). Reasons being that, ANOVA shows a p-value for abilities levels to be 0.02 which is significant and the p-value for that of Gender was found to be 0.76 higher than $p \leq 0.05$. When Ability level and Gender were also compared p-value of 0.94 was found to be higher than $p \leq 0.05$ level of significance. This means that between sex and varied abilities group, no significant differences exist. Therefore, the null hypothesis which states that there is no significant difference between the mean academic performance of male and female students of varied ability taught ecosystem concept using Computer Simulation Instruction (CSI) is hereby retained.

Discussion of the Findings
The result from the research question and testing of hypothesis one indicated that there is significant difference in the mean performance scores of Biology students with varied abilities exposed to computer simulation instruction and those exposed to lecture method. The significant difference found between the two groups is due to the use of computer simulation instruction on the experimental group. The significant difference in performance is in favour of the students in the experimental group which suggests a greater effectiveness of computer simulation instruction over the Lecture method of teaching. This implies that computer simulation instruction improves students' performance. This finding is in conformity with that of Ezeugwu (2010) and Nduke (2011) who found that students exposed to computer simulation instruction performed significantly better in the experimental groups than those in the control group. The findings is also in line with Joshua (2012), Yakubu (2012) and Ezeaghasi (2018) who suggested that the use of computer simulation instruction can enhance students' performance by helping them identify the strengths and weaknesses of their performance so that they can improve

their performance. Also, the result confirms with the findings of Ezeudu and Okeke (2013) who observed an increase in the academic performance of medium and slow learners in experimental group when taught with different simulation model in biology and chemistry outperform those taught the same concept using lecture method. However, the study contradicts that of Idris (2012) who found no significant difference in the mean achievement scores of students with varied abilities in the experimental and control group. Similarly, Starbak, Erjavec and Peklaj (2010) who reported that animated simulation does not significantly improve the performance of students with varied ability levels.

Hypothesis two indicated that there was no significant difference in the performance of male and female students with varied abilities exposed to computer simulation instruction. This finding indicates that gender has no effect on learning ecosystem concepts with Computer Simulation Instruction as a result of similar mean scores of the male and female students. This result is in line with the findings of Duyilemi, Olagunju and Olumide (2014) who work on computer simulation found out that there is no gender difference in the academic performance of secondary School students of varied abilities. This finding is also in agree with that of Uduosoro (2011), and Njoku (2012) Adu and Sheyin (2018) and Amedu (2015) in their individual studies reported no significant difference in the mean score performance and retention of boys and girls taught with different simulation method. This finding is however in disagreement with that of Jiya (2012) Umar (2013), Ibrahim (2016), who reported a significant difference in the performance of male and female of the experimental group-favouring male of the experimental. Also, in line with the Finding of this study, there is no gender difference in the academic performance of

Biology students of varied abilities exposed to computer simulation to arrive at a particular concept, it makes what they learn meaningful and promotes their understanding of the concept despite gender difference among the students.

Conclusion

Based on the findings of this study, the following conclusions were made:

1. The performance of Biology students with varied abilities in ecosystem can be enhanced through the use of Computer Simulation Instruction (CSI).
2. Computer Simulation Instruction (CSI) is more effective in increasing the performance of varied abilities students in Biology than the lecture method.
3. Computer Simulation Instruction (CSI) is gender friendly since both genders showed improved retention and performance.

Recommendations

On the basis of the findings and conclusions emanating from this study, the following recommendations are made:

1. Teachers should be encouraged to introduce the use of computer simulation instruction in teaching of some difficult and practical aspect in biology
2. Teachers should give more attention to medium and slow learners in other to increase their ways of assimilating things.

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