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Impact Of Computer-Simulation-Instruction On Performance In Ecosystem Among Secondary School Biology Student Of Varied Ability Level In Katsina State, Nigeria

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ABSTRACT
This study examined the impact of computer-simulation-instruction on performance in Ecosystem among secondary school Biology Students of varied ability level in Katsina State, Nigeria. The study was guided by two objectives, answer two research questions and tested two hypotheses. The study adopts pretest, posttest control group quasi–experimental research design. The target population for this study was 12,558 Senior Secondary Students in public Schools. The sample of the study was195 mixed ability students randomly drawn from the study area. This study utilized one validated research instruments with reliability coefficient of 0.8 and 0.9, namely: Ecosystem Performance Test (EPT). Research questions were answered using descriptive statistics in form of Mean, Standard deviation, Mean Rank and Sum of Ranks. Hypotheses were tested using ANCOVA at 0.05 level of significance. The finding of the study shows that performance of Biology students with varied abilities in ecosystem can be enhanced through the use of Computer Simulation Instructional Strategy (CSIS) and that it is gender friendly. Based on the findings, it recommended that Workshops, seminars and conferences should be organized by professional associations such as Science Teachers Association of Nigeria (STAN) and Nigeria Educational Research and Development Council (NERDC) for Biology teachers on how to use Computer Simulation Instructional Strategy (CSIS) in secondary schools, as a means of enhancing students' participation and performance.
Keywords: Biology, Computer-Simulation-Instruction, Performance, Ecosystem, Ability level

INTRODUCTION

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 (Lakpini, 2012), Studies conducted by Usman (2010) were carried out to improve the teaching and acquisition of scientific skills among students. Oludipe (2012), reported on students low academic achievement, which has become concern to parents, teachers, science educators, examination bodies and the 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.

The problem associated with the teaching of biology at Senior Secondary School level in Nigeria, according to Timothy (2013) and Ibrahim (2015) 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. Timothy, (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 (2010), 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. 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 is caused by the poor quality of biology teachers, overcrowded classrooms and inadequate instructional material and so on Challenges associated with teaching of Biology at the senior secondary school level includes pedagogical strategies, production and availability of instructional materials, enrolment and class size among others. Computer simulation 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. Therefore in this study the researcher will use CSI to see if it will help in solving the problem associated with teaching of Biology.

Computer Simulation Instruction Strategy (CSI) according to Linde (2013) is a recent development in search for more efficient training methods that will involve the integration of computer based programs. Hung (2011) opined that Computer simulation Instruction strategy (CSI) is used in educational drill practices, testing, tutorials, games, accumulative records and simulations. Abdullahi (2012), Baillie (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.

Ecosystem according to Michael (2015) refers to a community of plants and animals functioning together with their non-living environment. Ahmed and Abimbola (2012), stated that the secondary school Biology curriculum places the ecosystem concept to be studied and specified the performance objectives to be achieved as well as the activities to be carried out in the course of teaching and learning in order to facilitate the understanding of the concept being taught. According to the chief examiners reports West African Examination Council WAEC (2011, 2013 & 2015) shows that students' performance in ecosystem revealed a very low performance by students. One of the reasons students have difficulties in learning of ecosystem is inappropriate teaching method which has resulted in poor performance among secondary school students (Cimer 2012). The work of Omoifo (2012) shows that inadequate teaching methods has been advanced as one of the problems of teaching ecosystem in Nigerian secondary schools. Effective teaching occurs when students learn and achieve many scientific goals and not just being able to repeat scientific knowledge. Omorogbe and Ewansiha (2013) pointed out that, during effective learning, students learn how to learn. They develop conceptual understanding and thinking skills which help them change their intuitive ways of explaining the world around them to incorporate scientific concepts and ways of thinking into their personal frameworks. This enhances their performance and ability to solve problems. Ezeaghasi (2017) found that the use of computer simulation instruction enhanced students' performance in biology.

Ability level of students is also an important factor in enhancing the teaching and learning of science. According to Ofonime (2010) ability level as the degree of the exhibited capability of a student to learn and comprehend a concept as well as solve problems in it. Ahmed (2010) defined ability level as the placement of children in one classroom into groups, based on their abilities. Bitrus (2012)

maintained that there are two types of ability groupings. These consist of between- class and within - class ability groupings. Between-class ability grouping is a school-level practice; it refers to forming a classroom so that students of similar ability are placed together.

According to Ofonime (2010) described the high ability level students as students whose academic potentials are above class average and their achievement described as good. Lakpini (2012) stressed that the high-level ability students as whose academic potentials are above class average and their achievements described as good. James (2013) described the high achievers as those students who perform well in test, assignments and examinations. Middle (average) learners, these are the group of students who according to Awe (2003) can only record an average achievement, not because they are not capable of doing better, but partly because they cannot put in extra effort to attain better achievement. They are therefore, contented to remain average. For this reason, they content themselves with the classroom learning without trying to reach out to other information.

Gender is a specially constructed phenomenon that is brought about as society ascribes different roles, duties, behaviours, and mannerisms to the two sexes (Mangvwat, 2006). It is a social connotation that has sound psychological background, and it is used to refer to specific cultural patterns of behaviour that are attributed to human sexes. Akpochafo (2009), stated that gender relates to cultural attributes of both males and females. Gender according to Betiku (2012) refers to all the characteristics of male and female, which a particular society has determined and assigned each sex. Onyeukwu (2012) sees gender as the dichotomy of roles culturally imposed on the sexes. In most societies, gender has roles based on the women folk, preventing their participating in, and benefiting from development efforts this has created a big psychological alienation or depression in the minds of the female students. Akpochafo (2009) reported that in Nigeria as in many African societies, there is gender bias, a situation in which cultural beliefs and structural arrangement favors men over women. This can be witness in most of elective positions contestable by man and woman. People always see women as not fit to govern or rule since men are involved.

Okeke (2015) equally observed that, the Nigerian school curriculum is not gender fair since its contents reflect mainly the concerns of males; science careers portray masculine images in the curriculum; and more still, female suffer discrimination from teachers overtly & covertly, knowingly and unknowingly. Okeke (2015) further explain that these actions automatically put the girls in a disadvantaged position for performance in classroom interaction especially in science related subjects. Achievement test results conducted by Onekutu (2012) has shown that boys and girls in the early ages perform equally in all subjects including English language, and as they grow to higher classes, the girls begin to get more interested in language Arts, while the boys take more to sciences and Social Sciences.

Lecture method is a traditional talk and chalk method of teaching in which the teacher does most of the talk, while the students listen and write notes. This is the method of teaching that teachers embrace for easy coverage of the school syllabus (Obeka 2009). This method involves verbal presentation of ideas, concepts, and generalization of facts. It is used to introduce students to a new subject, summarize ideas, showing relationships between theory and practice and highlighting the main points. Lecture method is highly valued in a situation where the number of students, who are benefitting from it, is quite large and in a situation where there is inadequate number of competent and qualified teachers. This method does not promote optimum academic performance in science as observed by James (2009). But the aspect of relating the method of instruction to students' performance and interest in Biology is an area of study particularly at the senior secondary school. The Biology syllabus does not stipulate a particular teaching method course except the practical courses where laboratory work is suggested for the teachers. Teaching methods selected by teachers affect students' performance in science. In this study, lecture method will be use as a control variable to determine its effectiveness in relation to concept of ecosystem to see how it affects students' academic performance.

Problem Statement

Biology is one of the major subjects in Nigerian secondary school curriculum, as a result of its importance, more students enrolled for biology in the senior secondary certificate examination (SSCE) than for physics and chemistry (Timothy, 2013). The WAEC Chief Examiners reports revealed persistence poor academic performance in some Biology concepts such as ecosystem

ecology, genetics and evolution (WAEC, 2016 & 2017). Previous studies like Ahmed and Abimbola (2011) showed that, students have difficulties and misconceptions in ecosystem. This makes students hate the topic (ecosystem) and the situation leads to poor performance of students in Biology. Lakpini (2012) shows that performance of Biology student at senior secondary school level has remained poor, despite of the various efforts to improve the teaching and learning of Biology in Nigeria by different of researchers, The Chief Examiners' Report (WAEC 2011-2019) shown that less than 50% of students made credit and above in SSCE Biology results over the years. The total number of students that failed Biology over the years under review had relatively remained on the increase as the total enrolment increased yearly. Similarly, about 56% of candidates on the average could not pass Biology at Credit level to meet the minimum requirements for admission into higher institutions. This failure rate at SSCE according to Lawal (2010),) has continued to be a source of worry to curriculum planners, educationists, parents, and the entire society at large. Muoneme (2013) opined that students are at the same ability level during teaching and learning in the classroom. The low-ability students who need more attention are often neglected. There is therefore the need for Biology teachers to give proper attention to students of different ability levels especially low ability students so as to improve their performance, hence, this study investigated the effect of Computer Simulation Instructional Strategy (CSI) on performance of Biology students with Achievers level.

Objectives of the study

The study is design to achieve the following objectives:

1. investigate the effect of Computer Simulation Instructional Strategy (CSI) on performance of Biology students with varied abilities.
2. determine the effect of Computer Simulation Instructional Strategy (CSI) on performance of male and female students of varied abilities.

Research Questions

1. What is the difference between the mean performance of scores of students with achievers level taught ecosystem using CSI and those taught using lecture method?
2. What is the difference between the mean 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 to guide this study. The null hypotheses were tested at $P \leq 0.05$ level of significance.

1. **H01**: There is no significant difference between the mean 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.

METHODOLOGY

This study employed quasi-experimental control group design involving pre-test, post-test and post post-test. The study used two groups: experimental and control groups. A pre-test (0_1) was administered to both experimental and control groups using same test instrument before treatment; the pre-test scores was used to determine the varied ability level of the students (high, average and low). The treatment (X_1) was done by teaching ecosystem concepts to the experimental groups, using Computer Simulation Instructional Strategy (CSIS) by showing the ecosystem simulation videos while the control group was exposed to the same concept using lecture method. The post-test (0_2) was given to test if the treatment is effective or not by exposing to EPT performance test. After two weeks, post post-test (O_3) was administered to the students to determine their retention ability of ecosystem.

RESULTS

Answering the Research Questions and Testing Null Hypotheses

Research Question One: *What is the difference between the mean performance scores of students with varied ability level taught ecosystem using Computer Simulation Instructional Strategy (CSIS) and those taught using lecture method?*

To answer question one, a descriptive statistic of mean and standard deviation was used. The detail of the result is presented in Table 1a

Table 1a: Mean and Standard Deviation of Students of Experimental and 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 results in Table1a showed that the experimental group with mean of 51.40 for high ability, 46.70 for average ability and 43.70 for low ability sub-group performed higher than the control group with mean of 33.20 for High ability group, 28.30 for Average ability and 26.20 for low ability group. This implied that differences exist between the means of experimental and control group. To show whether the difference is significant or not, null hypothesis one was subjected to Two-way Analysis of Variance (ANOVA) statistics.

Null Hypothesis One: There is no significant difference between the mean performance scores of students with varied ability taught ecosystem using CSIS

To test null hypothesis one, post-test scores obtained from the Ecosystem Performance Test (Table1a) of the experimental and control groups were subjected to Two-way Analysis of Variance (ANOVA) statistics at P≤ 0.05. Summary of the analysis is presented in Table 1b.

Table 1b: 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

Result from Table1b showed that significant difference exists between the mean performance scores of Biology students of varied abilities levels taught with Computer Simulation Instructional Strategy (CSIS) 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 Instructional Strategy (CSIS) and those taught using lecture method is hereby rejected. This implies that there is significant difference between the performance of varied ability level students exposed to Computer Simulation Instructional Strategy (CSIS) and those exposed to lecture method. Thus, CSIS is found to be more effective in improving students' performance in ecosystem than the lecture method.

To show which groups among the ability groups of experimental and control group shows significant difference Scheffe's post hoc test was carried out as presented in Table 4.1c.

Table 1c: Summary of Post Hoc Tests (LSD) of Multiple Comparison Pair wise Between Experimental and Control Groups.

(I) Ability	(J) Ability	Mean Difference (I-J)	Std. Error	P-value	Remark
High	**Average**	8.87*	0.62	0.01	S
	Low	8.95*	0.73	0.01	S
Average	**High**	-8.87*	0.62	0.01	S
	Low	0.084	0.67	0.99	**NS**
Low	**High**	-8.95*	0.73	0.01	S
	Average	-0.084	0.67	0.99	NS

Significant at P ≤ 0.05

Table1c shows the that significant difference exist between the pair wise mean of high ability level compared with each of the mean of those in either average or low ability groups and vice versa. This is because in each pair wise comparison of means, the calculated p-value was found to be lower than 0.05 level of significance. 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 Instructional Strategy (CSIS) and their counterparts taught with lecture method is hereby rejected.

Research Question Two: *What is the difference between the mean performance scores of male and female Biology students with varied abilities taught ecosystem concept using Computer Simulation Instructional Strategy (CSIS)?*

To answer question two, a descriptive statistic of mean and standard deviation was used. The detail of the result is presented in Table 2a

Table 2a: 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					0.30
	14	Female	40.90	0.5	

From Table 2a, the mean performance scores of male and female in the experimental group for high ability is 48.40 and 48.20, Average ability is 44.50 and 44.60 and low ability with 40.70 and 40.90 respectively. This shows that the performance mean scores of male and female students exposed to CSIS are similar. To show the difference between the mean performance scores of male and female students of varied abilities taught with Computer Simulation Instructional Strategy (CSIS), data collected is subjected to Two-way Analysis of Variance (ANOVA)

Null Hypothesis Two: There is no significant difference between the mean academic performance of male and female secondary school biology students of varied ability taught ecosystem concept using Computer Simulation Instructional Strategy (CSIS).

To test null hypothesis two, post-test scores obtained from the Ecosystem Performance Test (Table 2a) of male and female students of varied ability level in experimental group were subjected to Two-way Analysis of Variance (ANOVA) statistics at P≤ 0.05. Summary of the analysis is presented in Table 2b.

Table 2b: 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**

Result from Table 2b showed that there is no significant difference in the mean scores of Male and female students of varied abilities levels taught with Computer Simulation Instructional Strategy (CSIS). Reasons being that the p- value for abilities levels vs sex is 0.94 which was found to be higher than p≤ 0.05 level of significance. The significant p-value for varied abilities was 0.02 and that of sex group was 0.76 was found to be higher than p≤ 0.05 levels 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 Instructional Strategy (CSIS) is hereby retained.

4.3 Summary of Findings

Based on the outcome of the analysis, the followings are the summary of the major findings of the study:

1. Significant difference exists in the mean performance scores of Biology students with varied abilities exposed Computer Simulation Instructional Strategy (CSIS) and their counterparts taught with lecture method.
2. There is no significant difference in the mea n performance scores of male and female Biology students with varied abilities exposed to Computer Simulation Instructional Strategy (CSIS). Thus, indicating that Computer Simulation Instructional Strategy (CSIS) is gender friendly

DISCUSSION OF THE RESULTS

The result from the research question and testing of hypothesis one as shown in Table 1a and Table 1b indicated that there is significant difference in the mean performance scores of Biology students with varied abilities exposed to Computer Simulation Instructional Strategy and those exposed to lecture method. The significant difference found between the two groups is due to the use of Computer Simulation Instructional Strategy 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 Instructional Strategy over the Lecture method of teaching. This implies that Computer Simulation Instructional Strategy improves students' performance. This finding is in conformity with that of Ezeugwu (2010) and Nduke (2011) who found that students exposed to Computer Simulation Instructional Strategy performed significantly better in the experimental groups than those in the control group. The findings is also in line with Joshua (2012) and Yakubu (2012) and Ezeaghasi Ngozi E, (2018) who suggested that the use of Computer Simulation Instructional Strategy 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) and Ojediran, Oludupe and Ehindero (2014) 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. but 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. However, Starbak, Erjavec and Peklaj(2010)who reported that animated simulation do not significantly improve the performance of students with varied ability levels.

The result of data analysis presented in Tables 2a and 2b showed that there was no significant difference in the performance of male and female students with varied abilities exposed to Computer Simulation Instructional Strategy. This finding indicates that gender has no effect on learning ecosystem concepts with Computer Simulation Instructional Strategy 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 also work on computer simulation found out that there is no gender difference in the academic performance of secondary School students of varied abilities. This findings is also in agree with that of Uduosoro (2011), and Njoku (2012) in their individual studies reported no significant difference in the mean score performance of boys and girls taught with different simulation method. This finding is however in disagreement with that of Ibrahim (2012 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 Instructional Strategy. Since the method allows students to construct their own knowledge and 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 Instructional Strategy (CSIS).
2. Computer Simulation Instructional Strategy (CSIS) is more effective in increasing the performance of varied abilities students in Biology than the lecture method.
3. Computer Simulation Instructional Strategy (CSIS) is gender friendly since both genders showed improved 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 method in teaching of some difficult and practical aspect in biology
2. There is need for government to provide learni ng aids including computers to teacher
3. Workshops, seminars and conferences should be organized by professional associations such as Science Teachers Association of Nigeria (STAN) and Nigeria Educational Research and Development Council (NERDC) for Biology teachers on how to use Computer Simulation Instructional Strategy (CSIS) in secondary schools, as a means of enhancing students' participation and performance.
4. Adequate funds should be provided by the government to sponsor Biology teachers and lecturers for retraining on Computer Simulation Instructional Strategy (CSIS) required to improve academic performance of students.
5. Since Computer Simulation Instructional Strategy (CSIS) is not gender bias, it could appropriately be useful in co-educational setting where both males and females come together to learn.

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