EFFICACY OF COMPUTER ASSISTED MULTIMEDIA INSTRUCTION ON STUDENTS' ACADEMIC PERFORMANCE AND RETENTION OF ECOLOGY IN SOME NORTHWESTERN STATES, NIGERIA

[1]Shamsudeen Bello, [2]Yahya Muhammad Kamar,
[3]Muhammad Awwal Yushau [4]Halima Sadiya Abubakar

[1]Sokoto State University, Nigeria;
[2,3,4]Usmanu Danfodiyo University Sokoto, Nigeria.

Email: [1]shamsudeenmarina@gmail.com;
[2]yahyakamar@yahoo.com; [3]yushauawwal@gmail.com; [4]halimasabubakar@gmail.com
[1]*Corresponding Author https://orcid.org/0000-0001-8563-3090

ABSTRACT

Introduction: The emergence of the computer in the 20th century, coupled with the development in its software design in the 21st century, made teachers and educational researchers to initiate the idea of incorporating computers and its gadgets or application software in teaching and learning.

Purpose: This study investigates the effectiveness of Computer Assisted Multimedia Instruction (CAMI) and school location on senior secondary school students' academic performance and retention of Ecology in Some Northwestern States, Nigeria.

Methodology: The study adopted quasi-experimental design involving experimental and control groups. The experimental group was taught using the CAMI package. The control group was taught using the Lecture method. The population of the study consists of 5331 SS 2 Biology students from 27 Science Secondary Schools in Sokoto, Kebbi and Zamfara States. The sampling procedures used are purposive and simple random sampling techniques. A total of 282 students were selected from six secondary schools in the three states (2 schools from each state). The instrument used for data collection was Ecology Performance Test (alternatives A and B). Alternative A was used for Pretest and Posttest while alternative B was used for Post-posttest. A reliability coefficient of 0.726 and 0.712 were obtained for alternatives A and B respectively after pilot study. The statistical tools used for data analyses includes Mean and Standard Deviations, independent t-test and ANOVA.

Results: The findings revealed among others that senior secondary school students taught ecology using CAMI performed higher than those taught with Lecture method. And school location has no effect on both academic performances of students and retention when CAMI method was used in teaching ecological concepts,

Recommendations/Classroom Implications: Biology teachers should incorporate Computer Assisted Multimedia Instruction alongside the Lecture method in teaching ecological concepts.

Keywords: Instruction, Location, Performance, Retention, Ecology

Bello, S., & Kamar, Y.M., Yushau, M.A., & Abubakar, H. S

PUBLIC INTEREST STATEMENT

The aim of any research is to bring about an increase in knowledge and provide solutions to the existing problem. the findings of this study will facilitating teaching and learning of ecological concept, suggest the use of CAMI as an alternative method to Field study among senior secondary school students in Sokoto, Kebbi and Zamfara States Nigeria.

INTRODUCTION

Man and environment are the bonded entity of the universe. The survival of man in the environment depends on his understanding of the natural factors (biotic and abiotic) surrounding him. The Agricultural experiences and development of science, especially Biological science provides man with knowledge and skills to alter and take full control of his surroundings. However, this human ability to understand, manipulate, and control his environment lead to possible damage of the natural ecosystems, resulting in many environmental issues and challenges like; Climate change, Global warming, Loss of biodiversity, Pollution erosion etc., hence the need for environmentally literate society. Consequently, the Nigeria Educational Research and Development Council (NERDC, 2009), included ecology as part of the experiences a learner should acquire in the Nigeria secondary school biology curriculum. The objective of the curriculum among others is to provide every person with opportunities to acquire knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment. Furthermore, the council recommends the use of field study in teaching the content of senior secondary school biology curriculum, including ecology. However, the Lecture method is the most widely used method of teaching in the Nigerian schools (Usman, 2008).

Snezana, Gudevab, and Djokicb (2011) reported that Lecture method makes students' academic performance low and also affects attention and motivation of students. Similarly, Wakhidah (2017), reported that learning about ecological concepts such as environmental pollution with the lecture method is less effective and makes students less active. Despite the limitations of this method, many teachers believed it is their only option. However, there are newly developed techniques of teaching which can involve students in the process of thinking, questioning, problem-solving, improving their retention and resulting in meaningful learning. Some of these techniques include multimedia learning and recently, computer-assisted instruction.

The emergence of the computer in the 20th century, coupled with the development in its software design in the 21st century, made teachers and educational researchers to initiate the idea of incorporating computers and its gadgets or application software in teaching and learning. This resulted in the development of several Computer Assisted Instruction packages purposely designed for learning. Computer Assisted Multimedia Instruction is a term coined for this research. It was mainly from two alternative or similar forms of instruction namely; Multimedia Instruction and Computer Assisted Instruction. Multimedia Instruction involves the use of various types of media such as Text, graphics, Images, Videos, and audio in the process of teaching and learning to build their mental representation (Mayer, 2005). Computer Assisted Instruction (CAI) on the other hand refers to the type of instruction aided or carried out with the help of a computer, and can be used for various types of instructions such as tutorial, problem solving, practical work demonstration and stimulation of students' interest in an instruction (Olagunju, Bolaji & Adesina, 2013). This study is based on cognitive multimedia learning theory which was developed by Richard E. Mayer who argued that multimedia supports the way human brain learns. The theory states that students learn extremely better when taught using multimedia involving pictures, videos, animations and text instead of words alone. The implication of the theory to ecology teaching is that teachers can use multimedia presentations to make lessons

more interesting by using pictures, videos and animations or even combining text with pictures and videos to explain some concepts or phenomena during the lesson. A multimedia Instruction can also students to read the text while viewing images from animation and videos.

Several literatures have identified the effectiveness of these instructional methods on academic performance and retention. For instance, Gambari, Yaki, Gana, and Ughovwa (2014) conducted an experiment on the use of video-based multimedia instruction in teaching biology. The study revealed that students taught with multimedia instruction performed better than their colleagues in the lecture method. Furthermore, Anita (2014) selected Senior Secondary Two (SSII) students to study the effectiveness of two forms of multimedia instructional deliveries namely; Videotaped instructions (VTI) and Powerpoint presentations (PPP) on students' academic performance and retention in biology. The result of the analysis of data obtained during the research showed that VTI had a significant effect on students' academic performance and retention in Biology than PPP.

Several studies were conducted to compare the effect of the Computer Assisted Instruction and Lecture method on students' academic performance and retention of biological concepts individually or as a group. For instance, Afolabi (2006) investigated the effects of Computer Assisted Instructional packages on secondary school students' performance in Biology, the findings showed that the performance of students exposed to CAI either individually or cooperatively was better than their counterparts exposed to the Lecture classroom instruction. Hakan and Azize (2015) compare the posttest scores of the students exposed to traditional teaching methods and those exposed to Computer-Assisted Instruction (CAI). The study found that students exposed to CAI have higher academic performance and Retention than students exposed to traditional methods.

Northwestern Nigeria is mainly grassland areas with some parts experiencing desert encroachment. Some other types of habitat that could be found in these areas include freshwater bodies like rivers, dams, ponds and marshy land. Preliminary survey conducted revealed that schools in the area do not have adequate vehicles for use during field study and the population of students offering biology is one of the highest among secondary schools in the states. Therefore, even if biology teachers are interested in using field study to teach these ecological concepts, there is no means to transport students. Thus, teachers are left with no option than to continue to employ the Lecture method in teaching ecological concepts.

STATEMENT OF THE PROBLEM

Field study is one of the recommended methods of teaching ecological concepts by the Nigeria Educational Research and Development Council (NERDC, 2009), However, there are several challenges of using this method in teaching ecological concepts like types of aquatic habitats (i.e Marine, Estuarine and Freshwater) and types of terrestrial habitat (i.e Marshy, forest, grassland and desert). For instance, to teach a student from Northwestern Nigeria about the characteristics of Marine, Estuarine or Forest using field study, such students need to be transported to parts of Nigeria where those habitats can be found. Similarly, to teach topics related to grassland and desert habitat to students in the southern part of Nigeria using field study, such students have to be moved to the parts of Nigeria where such types of habitat exist. This requires vehicles, accommodation, legal and parental permission which are very difficult to obtain. Furthermore, the current insecurity challenges experienced in north-west Nigeria has made the use of field study even more difficult.

In its annual examination report on students' performance, the West African Examination Council (WAEC, 2017) observed that inability to answer questions related to ecology and adaptation properly was among the weaknesses of Nigerian students which resulted in poor performance in 2017. Similarly, it was reported by the same

examination body that inability to state specific habitats of organisms presented as specimens during practical examination was another weakness of the candidates which contributed to poor performance in 2018 (WAEC, 2018).

Consequent upon the aforementioned challenges, and the development of other methods of instructions such as Multimedia learning and the use of Computer in learning, there is the need to investigate the effectiveness of these new methods in teaching ecology, this with a view to finding out the method that can complement field study in learning the ecological concept such as types of aquatic and terrestrial habitats, Adaptation, Association and Pollution.

PURPOSE OF THE STUDY

The following specific objectives were set to find out:

1. The difference in the academic performance of senior secondary school students' taught ecology using Computer Assisted Multimedia Instruction and those with Lecture Method in Sokoto, Kebbi and Zamfara States.
2. The difference in the retention of ecology between senior secondary school students' taught using Computer Assisted Multimedia Instruction and those with Lecture Method in Sokoto, Kebbi and Zamfara States.
3. The difference in the academic performance of senior secondary school students taught ecology using Computer Assisted Multimedia Instruction Sokoto, Kebbi and Zamfara States.
4. The difference in the retention of ecology among senior secondary school students taught using Computer Assisted Multimedia Instruction Sokoto, Kebbi and Zamfara States.

RESEARCH QUESTIONS

1. What is the difference between the academic performance of senior secondary school students' taught ecology using Computer Assisted Multimedia Instruction and those with Lecture Method in Sokoto, Kebbi and Zamfara States?
2. What is the difference in the retention of ecology concepts between senior secondary school students taught using Computer Assisted Multimedia Instruction and those with Lecture Method in Sokoto, Kebbi and Zamfara States?
3. What is the difference between the academic performance of senior secondary school students' taught ecology using Computer Assisted Multimedia Instruction Sokoto, Kebbi and Zamfara States?
4. What is the difference in the retention of ecology concepts among senior secondary school students taught using Computer Assisted Multimedia Instruction in Sokoto, Kebbi and Zamfara States?

HYPOTHESES

1. There is no significant difference between the academic performance of senior secondary school students' taught ecology using Computer Assisted Multimedia Instruction and those with Lecture Method in Sokoto, Kebbi and Zamfara States.
2. There is no significant difference in the retention of ecology concepts between senior secondary school students taught using Computer Assisted Multimedia Instruction and those with Lecture Method in Sokoto, Kebbi and Zamfara States.
3. There is no significant in the academic performance among senior secondary school students' taught ecology using Computer Assisted Multimedia Instruction Sokoto, Kebbi and Zamfara States.
4. There is no significant in the retention of ecology concepts among senior secondary school students taught using Computer Assisted Multimedia Instruction in Sokoto, Kebbi and Zamfara States.

METHODOLOGY
Research Designs

This study embraced quasi-experimental design with pretest-posttest control groups. It is characterized by

Bello, S., & Kamar, Y.M., Yushau, M.A., & Abubakar, H. S

administration of pretest and posttest to both groups, administration of treatment to the experimental group only and nonrandom assignment of subjects into experimental and control groups. The design thus suitable for the current study which aimed at identifying the effectiveness of CAMI on Academic performance and retention.

Population and Sample

The population of the study comprises of 5,331 SS 2 students from 27 Science Secondary Schools. The sample size used in the study is 282 which is lower than the recommended sample size by research advisor table (2006) for the population of the study. sampling procedures used in the study are purposive and simple random sampling techniques. Simple random sampling was used in selecting intact classes, while purposive sampling technique on the other hand was employed in selecting secondary schools that have satisfied the following criteria set for this study. Biology is currently not a compulsory subject in Nigeria secondary schools, therefore not all secondary schools or students offer biology as subject. Furthermore, the treatment package (CAMI) requires computer and electricity source Hence the reason for the criteria:

1. Offers Biology as subject to its senior secondary school students
2. Computer Laboratory/Equipment
3. Electricity supply
4. Having more than one SS 2 classes for random selection

Instruments for Data Collection

Two instruments were developed and used in this research, namely Computer Assisted Multimedia Instruction Package as treatment materials for the students in experimental group and Ecology Performance Test for data collection. The Computer Assisted Multimedia Instruction package was developed by the researcher with the help of a computer scientist. This was done after the researcher obtained videos and pictures relevant to the topics selected for this study, such as Aquatic habitats, Terrestrial habitats, Association between organisms, Tolerance, Adaptation for habitats and pollution. Videos obtained were edited using wonder-share filmora (an application used for editing videos) to create Short video clips used in describing some concepts or their characteristics. For example, a video clip showing waves, tides and diverse species of living organisms in an ocean was used in describing characteristics of marine habitats. Furthermore, relevant pictures downloaded were edited using adobe suits. The video clips and pictures were later integrated with text to develop a multimedia package using PowerPoint show, to describe the content of each topic selected for this study.

Ecology Performance Test is divided into two; alternative A and B. Alternative A was used for pretest and posttest, while alternative B was used as retention test (post-posttest) for both experimental and control groups. The questions that make up the EPT were obtained from the past question papers of the senior secondary school biology examinations organized by West African Examination Council (WAEC) and National Examination Council (NECO). The EPT is an objective test with each question having four options, one correct answer and three distractors. It covers the content of Ecology used during this research and consists of 30 Items each in alternative A and B.

The content Validation of EPT was done in two ways. Firstly, a table of specification was developed to ensure that all questions are within the content of the topics taught during the research and are in line with the performance objective set for each topic. Secondly, the EPT consisting of 50 items each for alternative A and B were presented to Test and measurement experts and experienced secondary school biology teachers for face validation. The use of simple language, reducing the number of questions, modification of some questions and sufficient instructions are among the observations raised during face validation. All observations and corrections made on EPT during face validation were affected before pilot study to ascertain the reliability of the instrument.

The reliability of the two EPTs was ascertained after pilot study. Two public secondary schools that were not used for this study were selected for the exercise. The schools have the same characteristics with the sample schools selected. Test-retest and measure of equivalence methods of estimating reliability were used. The students' scores of the first test were compared with their second test scores using Pearson Product Moment Correlation with the help of SPSS statistical software. A coefficient 0.726 and 0.712 were obtained for both alternative A and B.

Method(s) of Data Analysis
The statistical tools used for data analysis includes both descriptive and inferential statistics. The descriptive statistic involving mean and standard deviation was used to answer all research questions raised in this research. The inferential statistics employed for testing the null-hypotheses formulated is t-test for hypotheses 1 and 2 and ANOVA for hypotheses 3 and 4 at 0.05 level of significance. All the data analyses were carried out using Statistical Package for Social Science (SPSS) software.

RESULTS
Research Question 1: What is the difference between the academic performance of senior secondary school students' taught ecology using Computer Assisted Multimedia Instruction and those with Lecture Method in Sokoto, Kebbi and Zamfara States?

Table 1: Descriptive Statistic of Posttest Scores of Experimental Group I and Control Group

Groups	Treatment	N	Mean	Standard Deviation	Mean Difference
Experimental Group	CAMI	141	18.77	3.57	6.80
Control group	Lecture Method	141	11.96	2.63	

Source: Field work (2020)

The summary of descriptive statistic presented in Table 1 shows that experimental group I who were taught using Computer Assisted Multimedia Instruction has mean score of 18.77 and standard deviation 3.57, while control group who were taught using Lecture Method has mean score of 11.96 and standard deviation 2.63. The mean difference between the two groups is 6.80 in favour of experimental group I. This suggested that students in the experimental group I performed better than their counterparts in the control group. Thus provide answer to research question one which sought for the difference between academic performances of the Senior Secondary School Students taught using Computer Assisted Multimedia Instruction and those with Lecture Method in ecology, in Sokoto, Kebbi and Zamfara States.

Research Question 2: What is the difference in the retention of ecology concepts between senior secondary school students taught using Computer Assisted Multimedia Instruction and those with Lecture Method in Sokoto, Kebbi and Zamfara States?

Table 2: Descriptive Statistic of Post-Posttest Scores of Experimental Group I and Control Group

Groups	Treatment	N	Mean	Standard. Deviation	Mean Difference.
Experimental Group	CAMI	141	16.59	4.39	6.01
Control group	Lecture Method	141	10.58	2.34	

Source: Field work (2021)

The summary of descriptive statistic presented in Table 2 shows that experimental group I who were taught using Computer Assisted Multimedia Instruction has mean score of 16.59 and standard deviation 4.39, while control group who were taught using Lecture Method has mean score of 10.58 and standard deviation 2.34. The mean difference between the two groups is 6.01 in favour of experimental group I. This suggested that students in the experimental group I performed (retained) better than their counterparts in the control group. Consequently, it provides answer to research question five which sought for the difference in the retention of ecology concepts between senior secondary school students taught using Computer Assisted Multimedia Instruction and those with Lecture Method in Sokoto, Kebbi and Zamfara States.

Research Question 3: What is the difference between the academic performance of senior secondary school students' taught ecology using Computer Assisted Multimedia Instruction Sokoto, Kebbi and Zamfara States?
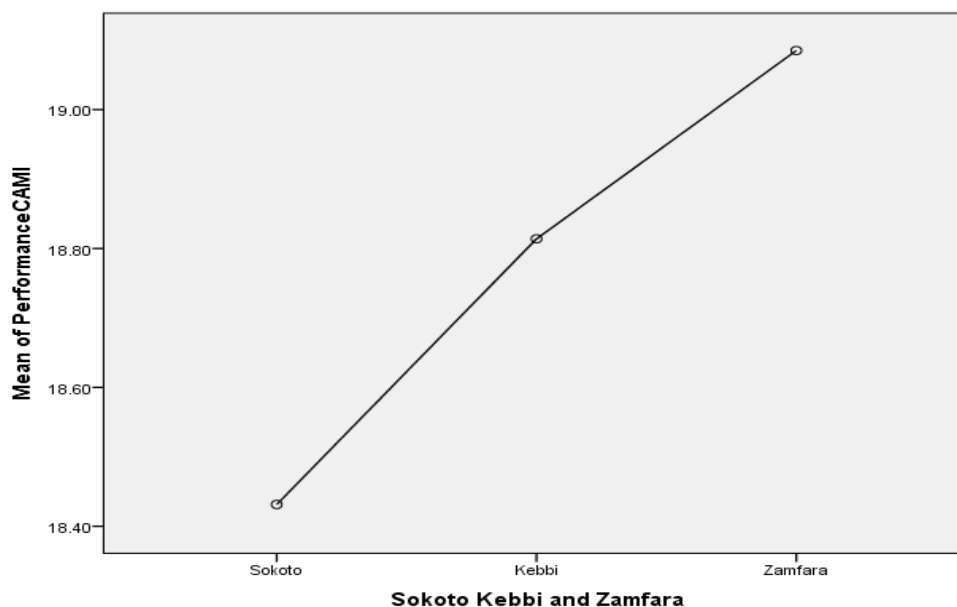

 Figure 1: Mean Performance graph of students in Sokoto, Kebbi and Zamfara State

The analyses on figure 1 above shows the mean score of students' academic performance taught ecology using CAMI in the three different locations. The graph indicated that student from Sokoto state have a mean score 18.43, those from kebbi have mean score 18. 81 while student from Zamfara have mean score 19.08. This revealed that student

Bello, S., & Kamar, Y.M., Yushau, M.A., & Abubakar, H. S

from Zamfara state performed slightly better than those from Kebbi and Sokoto, while students from Kebbi state performed slightly better than those from Sokoto state. This implies that, there is marginally small difference among students' academic performance in Sokoto, Kebbi and Zamfara State when taught ecology using CAMI, thus research question 3 was answered

Research Question 4: What is the difference in the retention of ecology concepts among senior secondary school students taught using Computer Assisted Multimedia Instruction in Sokoto, Kebbi and Zamfara States?
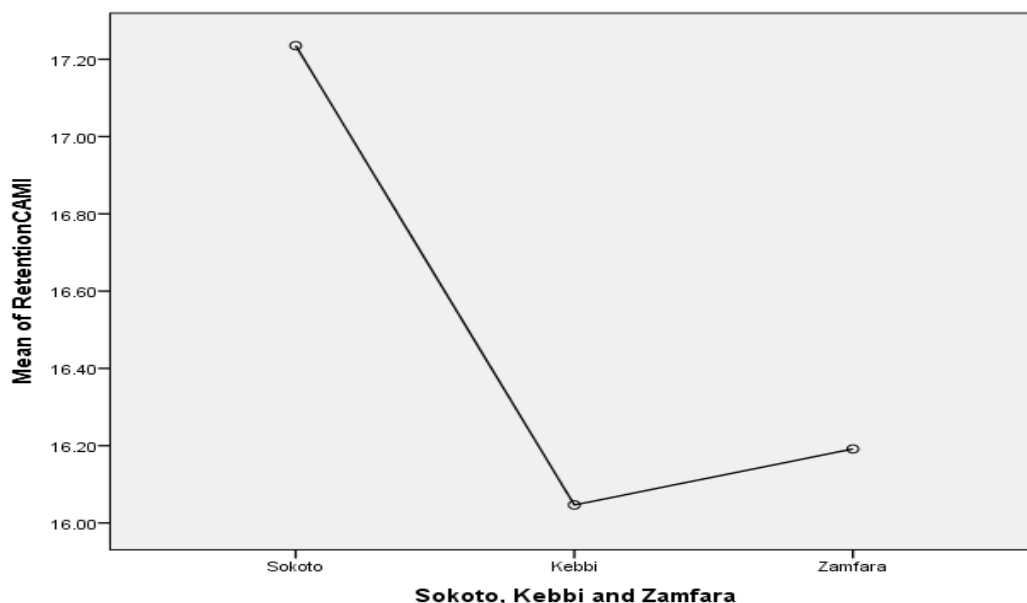
Figure 2: Mean Retention graph of students in Sokoto, Kebbi and Zamfara State

Figure 2 above shows the mean score of students' retention of ecological concepts when taught using CAMI in the three different locations. the graph showed that student from Sokoto state have a mean score 17.23, students from kebbi have mean score 16.05 while student from Zamfara have mean score 16.19. This revealed that student from Sokoto state retained slightly better than those from Kebbi and Zamfara, while students from Zamfara state retained slightly better than those from Kebbi state. This implies that, there is marginally

small difference among students' ability to retained ecological concept in Sokoto, Kebbi and Zamfara State when taught ecology using CAMI. Therefore, this answered research question 4.

Hypothesis 1: There is no significant difference in the academic performance between senior secondary school students taught ecology using Computer Assisted Multimedia Instruction and those with Lecture Method, in Sokoto, Kebbi and Zamfara States.

Bello, S., & Kamar, Y.M., Yushau, M.A., & Abubakar, H. S

Table 3: T-test Result of the Posttest Scores between Experimental group and Control group

Group	N	Mean	Standard Deviation	Mean Difference	P-Value	Decision
Experimental Group I	141	18.77	3.57			
				6.80	0.00	H_0 Rejected
Control Group	141	11.96	2.63			

Source: Field work (2021) $\qquad$ $\alpha = 0.05$

The result in Table 3 shows the summary of independent sample t-test analysis obtained after testing null-hypothesis one (H_0 1) which states that "There is no significant difference in the academic performance between Senior Secondary School Students taught using Computer Assisted Multimedia Instruction and those with Lecture Method in ecology, in Sokoto Kebbi and Zamfara State". The table shows that the p-value (0.000) is less than alpha value (0.05). This revealed that there is significant difference between the two groups of students, thus, hypothesis one (H_0 1) is rejected.

Hypothesis 2: There is no significant difference in the retention of ecology concepts between senior secondary school students taught using Concept Mapping and those with Lecture Method in Sokoto, Kebbi and Zamfara States.

Table 4: T-test Result of the Post-Posttest Scores between Experimental group and Control group

Group	N	Mean	Standard deviation	Mean difference	P-Value	Decision
Experimental Group I	141	16.59	4.39			
				6.01		
Control Group	141	10.58	2.34		0.000	H_o Rejected

Source: Field work (2021) $\qquad$ $\alpha = 0.05$

The result in Table 4 shows the summary of independent sample t-test analysis obtained after testing null-hypothesis five (H_0 5) which states that "There is no significant difference in the retention of ecology concepts between Senior Secondary School Students taught using Computer Assisted Multimedia Instruction and those with Lecture Method in Sokoto Kebbi and Zamfara". The figures in the table show that the p-value (0.000) was found to be less than the alpha value (0.05). This confirmed that there is significant difference between the two groups of students, thus, hypothesis five (H_o5) is rejected.

Hypothesis 3: There is no significant in the academic performance among senior secondary school students' taught ecology using Computer Assisted Multimedia Instruction Sokoto, Kebbi and Zamfara States.

Table 5: ANOVA Results Showing the Effect of Location on Performance with CAMI Treatment

Group	Sum of Squares	Mean square	P-Value	F Value	Decision
Between Groups	10.60	5.298			
			0.66	0.41	H_o Accepted
Within Groups	1776.68	12.875			
Total	1787.28				

The statistical values in Table 5 indicates a summary of analysis of variance on the Academic performance of Senior Secondary School Students in ecology among experimental group, who were taught using Computer Assisted Multimedia Instruction in three different locations. The mean square between and within the groups is 5.298 and 12.875 respectively. The p- value (0.41) was found to be higher than alpha value (0.05). This revealed that there is no significant difference in academic performance of students taught ecology using CAMI among the three locations. Thus H_o3 was accepted.

Hypothesis 4: There is no significant in the retention of ecology concepts among senior secondary school students taught using Computer Assisted Multimedia Instruction in Sokoto, Kebbi and Zamfara States.

Table 6: ANOVA Result Showing the Effect of Location on Retention with CAMI Treatment

Group	Sum of Squares	Mean square	P-Value	F Value	Decision
Between Groups	40.803	20.402			
			0.35	1.05	H_o Accepted
Within Groups	2690.360	19.495			
Total	2731.163				

Data contained on Table 6 shows summary of analysis of variance on the retention of ecological concepts among Senior Secondary School Students taught using Computer Assisted Multimedia Instruction in three different locations. The mean square between and within the groups is 20.402 and 19.495 respectively. The p- value (0.35) was found to be higher than alpha value (0.05). This revealed that there is no significant difference in the retention of ecological concept among secondary school students taught ecology using CAMI among the three locations. Thus H_o4 was accepted.

DISCUSSIONS

The first finding of this study shows that students taught ecology using Computer Assisted Multimedia Instruction score higher in the ecology performance test (posttest) than those taught using Lecture methods. This was revealed by data analysis results in Table 3 where the mean difference between experimental group I and control group (in favour of experimental group I) was found to be significant because the p-value (0.000) is less than alpha value (0.05). Thus, hypothesis one (Ho 1) was rejected. This implies Computer Assisted Multimedia Instruction being the treatment given to experimental group I is more effective than the Lecture method in enhancing senior secondary school students' academic performance in ecology. This finding concur with Asogwa and Ugwu (2007) who found that, using video images and pictures improve students' academic performance in biology topics

Bello, S., & Kamar, Y.M., Yushau, M.A., & Abubakar, H. S

such as pollution, conservation of resources and organic evolution. This study is similar to that of Asogwa and Ugwu (2007) because video images were also used to teach ecological concepts, the difference between the two is that this study did not used video-taped, but rather integrated video images in the computer multimedia packages, here computer was used instead of video-tape player. Similarly, the finding also supported Yamauchi (2008); (2012) and Gambari et al (2014) who revealed in their separate research that students taught using Multimedia Instruction performed significantly better than those taught using Lecture method of instruction. Furthermore, this finding reinforced other findings on the effectiveness of Computer Assisted Instruction and its supremacy over lecture method in improving students' academic performance biological concepts (Yusuf & Afolabi, 2010); Hakan & Azize, 2015).

The second finding of this study disclosed that students taught ecology using Computer Assisted Multimedia Instruction score higher in retention tests than those taught using lecture methods. The analysis on Table 4 indicated that the mean difference between senior secondary school students taught ecology using Computer Assisted Multimedia Instruction and those with Lecture Method is significant because the p-value (0.000) is less than alpha value (0.05). Thus, hypothesis five was rejected. This implies that Computer Assisted Multimedia Instruction makes students retain ecological concepts better than the Lecture method. This finding refuted Gambari et al (2014) who reported that students taught with Lecture teaching methods had better retention than those taught using multimedia instructional strategy. The difference between the present study and Gambari et al (2014) is that in their study, the students taught using multimedia instruction are divided into three experimental groups; group I was taught using Animation and Narration, group II was taught using Animation and On-screen Text, group III were taught using Animation, Narration and On-screen Text). However, in the present research, students in experimental group I were exposed to all the multimedia (Video, pictures, animations, narration and on-screen text. On the other hand, the findings corroborated Anita (2014) who concluded that students taught using multimedia instruction retained more knowledge than their colleagues taught using Lecture method. It also supported other findings on the effectiveness of Computer Assisted Instructions such as; Hussain and Ali (2012), who revealed that students taught using CAI retained more concepts for a very long period of time than their counterparts who were taught using Lecture method. Similarly, it agrees with Haken and Azize (2015) who revealed that CAI is more successful than the Lecture method in enabling retention. This finding further proved the multimedia learning theory which states that people learn more deeply from words and pictures than from words alone.

The third and fourth findings shows that school location has no effect on students' academic performance and retention of ecological concept when Computer Assisted Multimedia Instruction was used. This discovery was made after comparing academic performance and retention of student taught ecology using Computer Assisted Multimedia Instruction in three different locations (Sokoto, Kebbi and Zamfara State). This implies that computer assisted multimedia instruction can be used in teaching secondary school students regardless of the school location. The Findings contradicted Owoeye and Yara (2011) who reported that there is relationship between the location of schools and academic performance of students. Furthermore, the findings disagree with Iroegbu (2017) whose study found that the location of schools is an important variable that affect the achievement of pupils in both teaching and learning strategies used in the study.

CONCLUSION

Research on teaching and learning strategy were conducted by several researchers with contradicting outcomes, findings of this study supported some and contradicted others. Based on the major

Bello, S., & Kamar, Y.M., Yushau, M.A., & Abubakar, H. S

findings, it was concluded that Computer Assisted Multimedia Instruction is more effective than lecture method in improving senior secondary school students' Academic Performance and retention of ecological concepts, reason for this is attributed to the videos, audios and pictures contained in the multimedia package presented to students which enable them to observe footage of various ecological concepts and phenomenon. Furthermore, multimedia is currently in used everywhere especially in Computers and mobile phones. Thus, the study concludes that school location has no effect on both academic performances of students and retention when CAMI method was used in teaching ecological concepts. Thus, the method can be used as an alternative to field study in teaching ecological concepts especially for topics like characteristics of various types of habitats, pollution, ecological managements etc. Moreover, additional studies with different method and approaches may yield different result

RECOMMENDATIONS
1. There is a need for Biology teachers to incorporate Computer Assisted Multimedia Instruction alongside the Lecture method in teaching ecological concepts, with a view to enhancing their academic performance.
2. Principals and other stakeholders in education should encourage the use of Computer Assisted Multimedia Instruction for better retention of ecological concepts
3. Biology teachers should Prioritized the use of Computer Assisted Multimedia Instruction than Concept Mapping Learning strategy with a view to improving retention of ecology

Conflicts of Interest: The authors declare no conflict of interest

Disclaimer Statement
This work was extracted from the PhD. thesis submitted to the Department of Science and Vocational Education for the award of Doctor of Philosophy Degree in science education. It was Spervised by Prof. Y. M. Kamar, Prof. M. A. Yusha'u and Prof H. S. Abubakar.

Notes on Authors
Shamsudeen Bello is a PhD. student at the Department of Science and Vocational Education, Usmanu Danfodiyo University, Sokoto, Nigeria. He had successfully submitted his work for external examination. thus he is due for graduation soon. He is currently a lecturer with the Department of Science Education, Sokoto State University, Sokoto State, Nigeria

Yahya Muhammad Kamar is a Professor of science education at the Department of Science and Vocational Education, Usmanu Danfodiyo University, Sokoto, Nigeria. He is an experience science educator, curriculum specialist and expert in educational research with over 37 years of university teaching and supervisions of postgraduate research works. He is a full member of the Science Teachers Association of Nigeria (STAN), and was able to published numerous academic articles in both local and International Journals.

Muhammad Awwal Yusha'u is a Professor of Mthematics Education at the Department of Science and Vocational Education, Usmanu Danfodiyo University, Sokoto, Nigeria. He has published many academic article in reputable journals locally and internationally. Yusha'u is a Fellow and vice president of the Mathematical Association of Nigeria, with over 30 years of teaching across secondary school, college of education and university. He was also able to

supervised many Master dissertations and PhD. theses.

Halima Sadiya Abubakar is a Professor of guidance and counselling at the Department of Educational Foundations, Usmanu Danfodiyo University, Sokoto, Nigeria. She is a Member of Counselors Association of Nigeria with nearly 30 years of teaching across secondary school, college of education and University. Halima has published several academic works in both local and international journals and supervised many postgraduate research works.

REFERENCES

Afolabi, A. O. (2006). *Effects of computer assisted instructional package on secondary school students' performance in biology, in Oyo Nigeria*. (Unpublished Ph.D. thesis), University of Ilorin, Nigeria.

Anita, A. C. (2014). *Effects of two instructional delivery approaches for senior secondary school students' academic performance and retention in biology* (Unpublished master's thesis) University of Nigeria, Nsukka.

Asogwa, U. D., & Ugwu, B. O (2007). Effects of video and audio-taped instructions on students' academic performance in biology in secondary schools. *The Nigerian Journal of Research and Production, 11* (4), 1-6.

Gambari, I. A., Yaki, A. A., Gana E. S., & Ughovwa, Q. E. (2014). Improving secondary school students' academic performance and retention in biology through video-based multimedia instruction. *A Journal of Scholarly Teaching, 2*(2), 13-19.

Hakan Y., & Azize Y. (2015). The effect of the computer assisted instruction on the academic academic performance and retention of technical programme students' in vocational foreign language. *Procedia - Social and Behavioral Sciences* 174, 2513 – 2518.

Hussain, L., & Ali, U. (2012). Role of computer assisted instruction on the interest and retention of students at secondary school level. *Academic Research International, 3* (2), 336-344.

Iroegbu, V. I. (2017). Effects of strategy of teaching and school location on primary school pupils' achievement in English language. *Journal of Education & Social Policy 4*, (2), 64-71.

Mayer, R. E. (2005). Introduction to multimedia learning. In R.E. Mayer (Ed.), *The cambridge handbook of multimedia learning.* Cambridge University Press.

Nigeria Educational Research and Development Council (2009). *Senior secondary school biology curriculum.* NERDC Printing Press

Olagunju, A. M., Bolaji O. A., & Adesina A. E. (2012). Trajecting teacher education through computer assisted instruction for national development. *Journal of Modern Education Review, 3,* (12), 932 – 941.

Owoeye, J. S., & Yara, P. O. (2011). School location and academic achievement of secondary school in Ekiti State. Nigeria. *Asian Social Science 7,* (5). 1-7. doi:10.5539/ass.v7n5p170.

Snezana, S. V., Gudevab, L. K., & Djokicb M. (2011). The effect of teaching methods on cognitive achievement in biology studying. *Elsevier Proceeding of Social and Behavioural Sciences*, *15,* 2521-2527

Usman, I. (2008). *The relationship between students' performance in practical activities and their academic achievement! integrated science using NISTEP mode of teaching*. (Unpublished Ph.D Thesis) Ahmadu Bello University, Zaria, Nigeria.

Wakhidah, N. (2017). Improving learning outcomes of ecological concept using scaffolding strategy on scientific approach. *International Journal of Education*, 9 (1), 22-32. Doi:10.5296/ije.v9i1.10020.

Bello, S., & Kamar, Y.M., Yushau, M.A., & Abubakar, H. S

West African Examination Council (2017). The *chief examiners' report: general comment, weakness and strength.* www.waeconline.org.ng/e-learning

West African Examination Council (2018). The *chief examiners' report: general comment, weakness and strength*. www.waeconline.org.ng/e-learning