A Comparative Analysis on the Academic performance of Basic Science Students Taught Using Computer Simulation Approach and Lecture method in Bayelsa East Senatorial District, Nigeria

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DOI: 10.56201/ijee.v10.no1.2024.pg192.204

Abstract

The Study investigated A comparative Analysis on the Academic performance of Basic Science Students Taught Using Computer Simulation Approach and Lecture Method in Bayelsa East Senatorial District in Bayelsa State, Nigeria. The study was guided with two objectives, two research questions and two hypotheses. A population of three hundred and fifty-two (352) students was used for the study, while the sample size consisted of one hundred (100) students. The study adopted a quasi-experimental research design of pretest-posttest control type. The research instruments that were used for the study was the Basic Science Performance Test and Basic Science Retention Test designed by the researcher. The instruments had reliability coefficient of 0.65 and 0.68 respectively calculated using Cronbach Alpha reliability formula. The data obtained from students' response were analyzed using Mean and Standard Deviation to answer the research questions and Analysis of Covariance for test of the null hypotheses. Findings of the study showed that student taught Basic Science concepts using computer simulation approach performed better than those taught using lecture method. Based on the findings, it was recommended that teachers of Basic Science should adopt computer simulation approach in the teaching and learning of the subject in order to improve students' academic performance and retention level of the concepts, serving teachers should be trained and retrained on the job to improve on these innovative method of instruction. This can be done through seminars, conferences, workshops organized by both governmental and non-governmental agencies like the Science Teachers Association of Nigeria (STAN).

Keywords: *Comparative Analysis, Academic Performance, Basic Science Students Computer Simulation Approach and Lecture Method*

Introduction

The field of education has been affected by the on-going trends in the field of technology. This has led to the introduction of automation into education and has also helped the learner to adjust to the rapid changes in his environment as created by technology. Science Education as a discipline inter-relates between science as a discipline and the application of educational principles to its understanding, teaching and learning. Basically, Science Education which comprises Biology, Chemistry, Physics and Mathematics is a field specifically concerned with two basic aims; the production of a scientifically literate society and the development of potential scientific and technological manpower. Science Education is a discipline that produces the needed technologists and technicians as well as skilled scientific literate citizens who are required to turn the nations' economy around and usher in the desired technological advancement. Science Education imparts general knowledge and broadminded attitude to the population and produces creative specialists in various areas of human activity. Science and technology are the underlying bedrocks for socio-economic development of any nation. The social and economic developments of the nation therefore rest heavily on the level of scientific literacy of the citizenry and the ability to effectively utilize the scientific methods available for solving societal problems.

Science Education lays the foundation for future work in science and science related fields by acquainting the students with certain basic knowledge, skills and attitudes. Science development is concerned with the application of science to human actions. These actions could be in terms of individuals using scientific principles to produce technology or to influence others to learn science. Learning of science subjects in the secondary schools depends on certain fundamental factors such as; background of the students, availability of teaching materials, quality and quantity of teachers, adequacy of the laboratories and laboratory equipment/facilities, functional educational policies and psychological factors, (Ayogu, 2001, Arokoyu and Nwafor, 2014, Akinola and Fagbemi, 2017, Eniayeju, 2001 and Bonkole, 2001). In a classroom where cognitive strategies are used, the teacher fulfills a pivotal role, bridging the gap between the students and content/skill to be learned. This role requires an understanding of the task to be completed, as well as knowledge of an approach (or approaches) to the task that he/she can communicate to the learner. Approaches used in Basic Science teaching should be such that will increase students' cognitive process and manipulative skills. Therefore, for the purpose of learning to be effectively understood, it requires the learner to consciously construct meaning of what is to be learned. In an attempt to help students learn and understand Basic Science contents, the computer simulation method of teaching is adopted in this study.

Academic performance is the measurement of student cognitive, affective and psychomotor domains across various academic subjects. Teachers and education officials typically measure achievement using classroom performance, graduation rates and results from standardized tests. It is the result of learning, prompted by the teaching activity of the teacher and produced by the outcome of the learner. Academic achievement has to do with what a learner is able to accomplish by execution of class work in the school. Stiggings (2016) sees academic achievement as something a learner do or achieve at school, college or university, in class, in a laboratory or field work. Wentling (2015) opined that academic achievement refers to achievement of

individual's objective to various types of knowledge and skills. Here objective are established based on the age, prior learning and capacity of individuals with regards to education, socialization and qualification.

Some of the purpose of academic performance measurement are as follows; to determine the relative effectiveness of a program in terms of students' behavioral outputs; to identify students growth or lack of growth in acquiring desirable knowledge skills, attitudes and social values; to help teachers determine the effectiveness of their teaching technique and learning material; to help motivate students to learn as they discover their progress or lack of progress in given task; to encourage students to develop a sense of discipline and systematic study habits; to acquaint parents or guardians with their children performance; to predict the general trend in the development of teaching-learning process; to make reliable decision about education planning and to provide educational administrators with adequate information about teachers effectiveness and school need. In summary, academic performance measurement is very important in schools, colleges and universities. It is relevant to instructional, administrative, guidance and counseling and research purposes.

In educational institution, academic performance is the outcome of educational goals that are achieved either by students or the teachers that is, how well a student meets standards set out by local authority in the institution. Academic performance refers to how students' deal with their subject and how they cope with or accomplish different tasks given to them by their teachers. It is the ability to study and remember facts and being able to communicate their knowledge verbally. Sampson (2017) demonstrated that students' perception about subjects (Physics) is influenced by their parents, peers, the media, and their teachers. Teachers and peers that are involved with senior secondary school Physics should be communicating their perception to students unsure of their academic futures. A study in Israel conducted by Mualem and Elyon (2017) discussed the effect of teachers' perception on their students; an important area to address when contemplating where students get their presumption of Physics. The results showed that although the western educational community believes in the importance of exposing students to Physics at the Junior Secondary School level, many Junior Secondary School students have difficulty in understanding science conceptually and have a distress of Biology at the Senior Secondary School level.

Arshavskly (2017) described computer simulation as a professionally designed game that can excellently aid learning in that it incorporates courses into games. It involves using games and play to teach integrated science making students lively and actively involved in learning. An educational game is an activity in which players use data and/or skills usually in a competitive situation. . It is useful in presenting repetitive learning in normal ways; every student is active here and even the passive learner participates .Games can assist in creating awareness, reinforcing facts and knowledge, teaching skills and building values. Games provide an innovative educative entertainment and participatory approach to learning. Little wonder Fok (2017) described simulation as ways to imitate the operation of real-world systems. Computer Simulation which is the independent variable or predictor is an attempt to model a real-life or hypothetical situation on a computer so that it can be studied to see how the system works. Computer Simulation is the process of mathematical modelling, performance on a computer, which is designed to predict the behavior of another system modelled after it.

Computer simulation refers to the imitation of real world activities and processes in a safe environment. Simulation aims, to provide an experience as close to the 'real thing', as possible. A simulation instructional strategy has the advantage of allowing teachers come together to reset the scenario and try alternative strategies and approaches towards teaching and learning. This allows learners to develop experience of specific solutions by applying their wider learning and knowledge. Simulation is like a catalyst that speeds up by impartation of educational potentials and student's learning; thereby giving room for students to learn by discovery methods. This approach is frequently used in Physics where students needed to develop skills and experience in experiments. For instance science students in Physics stimulation class allowed students to practise collaboration and measurement on equipment that read in sophisticated and fairly realistic ways in application as in training pilots and aeronautical students. Simulation is a very general and flexible teaching approach that could be used in most disciplines but this means that how it will be implemented varies greatly.

The key to simulation is dynamic in that experiences are fixed. Tashin and Kandemir (2019) in their studies found out that students taught using simulation method were more successful than the students taught by the traditional approach. Adaptation becomes imperative as it is a sense where mechanism for learners to obtain real-life experiences on their actions. For instance, an exercise for software Physics student could involve the creation of a piece of software or system according to a realistic design specification. It involved changes and requirement being created by the teacher. During this practice, time is given to contemplate each decision where a slow process is being stimulated and there would be a lot of time waiting for an effect to decide being able to adjust the time-scale of the simulation which allowed students to make more cogent decisions which reflected on their choices in underlying the result in great details.

Computer simulation is a computer-generated imitation of real-world process, system or event. Broadly defined, computer simulations are computer-generated dynamic models that present theoretical or simplified models of real-world components, phenomena, or processes. They can include animations, visualizations, and interactive laboratory experiments. It promotes participation and retention of ideas. It is on this premise that the study intends to compare the academic performance of basic science students taught using computer simulation approach and lecture method.

Statement of the Problem

Over the years research and preliminary investigations have shown that most science teachers adopt conventional teaching methods which are teacher-centered and subsequently result to poor learning outcomes.

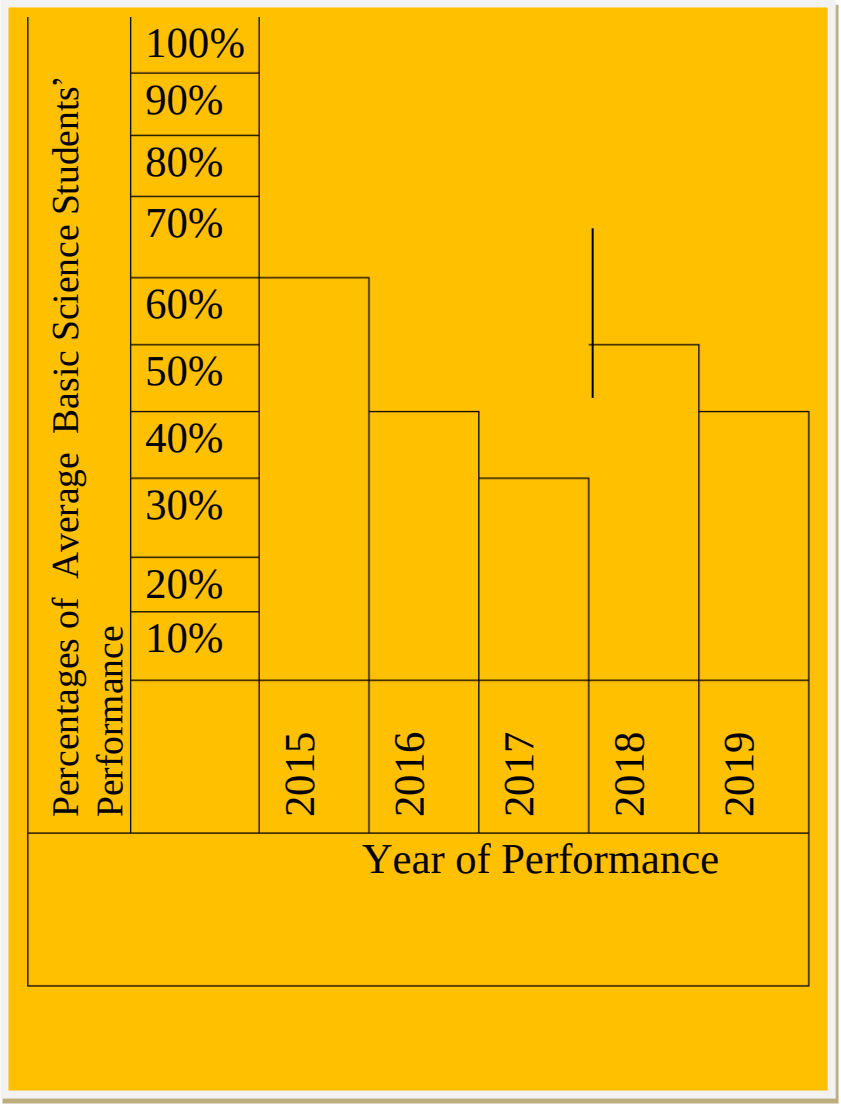

Figure 1.1: Bar Chart Showing Average Basic Science Students' Performance from 2015 to 2019 in Bayelsa East Senatorial District

This has raised doubts among science educators about the efficacy of teaching methods and approaches adopted over the years. Students' interest and academic performance in Basic Science depends on many factors and stands out to show how well the subject is being taught. Students' cognitive and manipulative performance may become more positive if the said students are being exposed to other instructional strategies of instruction like computer simulation, collaborative strategy, flipped classroom strategy etc. The adoption and the use of these strategies in teaching and learning of science based subjects is essential, mostly when the expected results have not been achieved in students' external as well as internal examination. This brings to

limelight the need for more effective teaching strategies, possibly the computer simulation strategy of teaching which can promote internalization of abstract concepts and enable the realization of goals of teaching science. Therefore, the study focused on comparing the academic performance of basic science students taught using computer simulation approach and lecture method.

Aim and Objectives of the Study

1. To compare the effect of academic performance of Basic Science students taught using computer simulation approach and lecture method.
2. To examine the level of retention ability of Basic Science students taught using computer simulation approach and lecture method.

Research Questions

1. What is the effect of academic performance of JSS 2 Basic Science students taught using computer simulation approach and lecture method?
2. What is the level of retention ability of JSS 2 Basic Science students taught using computer simulation approach and lecture method?

Hypotheses

Ho_1**:** There is no significant difference in JSS 2 Basic Science students' mean performance scores using computer simulation approach and lecture method.

Ho_2: There is no significant difference in JSS 2 Basic Science students' retention scores using computer simulation approach and lecture method.

Theoretical Review

Engagement Theory by Kearsley and Schniderman (1998)

Engagement theory is a framework for technology based teaching and learning, (Kearsley and Schnidermann, 1998). Its fundamental underlying idea is that students must be meaningfully engaged in learning activities through interaction with others and worthwhile tasks. Kearsley and Schniderman believe that technology can facilitate engagement in ways which are difficult to achieve otherwise. Engagement theory is based upon the idea of creating successful collaborative teams that work on ambiguous projects that are meaningful to someone outside the classroom. These three components, Relate-Create-Donate summarized imply that learning activities:

- occur in a group context (collaborative)
- are project-based and
- have an outside (authentic) focus.

The first principle (the "Relate" component) emphasizes team efforts that involve communication, planning, management and social skills. The modern workplace demands proficiency in these skills, yet historically students have been taught to work and learn on their own. Research on collaborative learning suggests that in the process of collaboration, students are forced to clarify and verbalize their problems, thereby facilitating solutions. Collaboration also

increases the motivation of students to learn. Furthermore, when students work in teams, they often have the opportunity to work with others from quite different backgrounds and this facilitates an understanding of diversity and multiple perspectives.

The second principle (the "Create" component) makes learning a creative, purposeful activity. Students have to define the project (problem domain) and focus their efforts on application of ideas to a specific context. Conducting their own projects is much more interesting to students than answering sterile textbook problems. And because they get to define the nature of the project (even if they don't choose the topic), they have a sense of control over their learning which is absent in traditional classroom setting. Project orientation is the essence of Problem-Based Learning (PBL) approaches which are often used in medical and others types of professional education. The third principle (the "Donate" component) stresses the value of making a useful contribution while learning. Ideally each project has an outside "customer" that the project is being conducted for. The customer could be a campus group, community organization, school, church, library, museum, government agency, local business, or needy individual. In many cases, the projects can be work-related, i.e., an activity that fits into a team's occupational or career interests. The authentic learning context of the project increases student motivation and satisfaction. This principle is consistent with the emphasis on school-to-work programs in many schools' systems and colleges, as well as the "service" philosophy of contemporary corporate training efforts.

Engagement theory is different from many older models of computer-based learning in which the emphasis was on individualized instruction and interactivity. Engagement theory does promote interaction, but human interaction in the context of group activities, not individual interaction with an instructional program. The latter form of interaction tended to be measured by single responses (e.g., key presses or mouse clicks) whereas engagement requires assessment of larger units of work (e.g., reports, programs, user satisfaction). The difference between engagement and interactivity reflects the shift in thinking about computers in education as communication tools rather than some form of media delivery devices. Furthermore, engagement theory places a great deal of emphasis on providing an authentic (meaningful) setting for learning, something not present in previous models.

However, this theory is applicable to the present study in that it fosters interaction with peers, allows student to engage together in performing tasks through collaborative teams and social skills. This enables students to engage in the problem solving method of developing hypotheses and reasoning plausible solutions. Children can think of abstract concepts and have the ability to combine various ideas to create new ones. By the end of this stage, children have developed logical and systematic thinking and can create hypothetical ideas to explain various concepts.

Emperical Review

Sabiru (2015) carried out a research on the effect of using computer simulation on Chemistry students' academic performance and anxiety level in balancing chemical equations in secondary schools in Katsina Metropolis, Nigeria. Using a sample size of 100 SS 2 students randomly selected from two senior secondary schools in Katsina Metropolis. The result obtained showed that students taught using computer simulation recorded high academic performance than those taught using conventional method. The study also reported that the anxiety level of students

taught using computer simulation tended to be low when compared with students taught using conventional method. Clark (2018) carried out a study with a sample consisting of sixty-five (65) first year Chemistry students at the Chemistry Department, University of Witwatersrand. Two sets of experiments where performed, one on the use of computer simulation while the other on the use of lecture method. The results obtained showed that students using computer simulation approach expressed positive attitudes in their performances. The post-test mean scores of the experimental group were observed to be higher than the control group. In this particular study greater knowledge gains were obtained from computer simulation. The study also reported the advantages of teaching science students using computer simulation, as it helps students to develop manipulative skills between what was learnt and what will be learnt.

Gadak (2015) used computer simulation in schools and observe its influence on the learning and teaching of Chemistry. Four schools in the city of Beira were chosen for the study, whereby two schools served as an experimental group where the computer simulation was used and the other two were used as control group where no computer simulation was used. The influence was measured by administering a pre-questionnaire and after eight weeks of intervention in the experimental group (where the computer simulation was used to support the teaching of Chemistry) a post-questionnaire in all four schools. The results revealed that the learners from the experimental group performed better on average than learners from the control group in the questions which required conceptual understanding and in laboratory based knowledge questions. This difference was attributed to the use of the computer simulation.

A study also carried out by Malayi (2018) in Ghana comparing the use of computer simulation in teaching solubility and precipitation and the traditional or conventional teaching approach on students 'performance showed that, using a control group (traditional teaching approach) of 107 students and an experimental group (task hierarchy analysis) of 88 students, the findings of the study indicated that the overall students' reactions to the task hierarchy analysis were vastly positive. Similarly, the result also revealed that most students were excited with hierarchy analysis practical experience. Explaining that it is interactive and enjoyable allowing them to form synergy between the previous knowledge, collaborates with peers and communicates with their teachers freely. Besides the affective outcomes, the findings showed that students exposed to the computer simulation of instruction developed better scientific reasoning skills by engaging in small group discussions and reflections during the classroom exercise.

Kumar (2018) conducted a study to investigate the effectiveness of Computer simulation on Senior Secondary student's achievement in practical Physics in Education district in Lagos State, Nigeria. A non-randomized, pretest and post-test, control group, quasi-experimental research design was adopted for the study. A sample of two hundred and nineteen (219) senior secondary school 2 Physics students, drawn by multistage sampling method from six co-educational schools in Educational district were used. Three research instruments in Practical Physics Achievement test (PPAT), Practical Skills Rating Scales (PSRS) and student's attitude inventing scale were also validated. The study revealed that the students 'in the experimental group (Computer Simulation) Instructional strategies had a higher mean in both the achievement and acquisition of practical skills than their counterparts did in the control (convectional) group. Instructional strategy attitude had significant effect. However, there were significant interaction effort of treatment and attitude in the senior secondary school's achievement in Physics practical.

Anthony (2019) revealed that senior secondary students have difficulties in learning certain chemical concepts such as solubility, electrolysis, redox reaction, chemical equilibrium and balancing chemical equations. To achieve mastering of balancing chemical equation and other concepts in Chemistry, several instructional strategies are devised over the years. The earliest and perhaps the least affective teaching method is the expository method, commonly referred to as the traditional method, the lecture method or chalk and talk method. Over the years science educators have been using the lecture method of teaching balancing chemical equations with little or no activities, which makes the concept difficult for students to grasp (Anthony, 2019).

Ematen, and Watson (2017) studied the effect of simulation technique in testing the academic performance of students' in Basic Science in three groups. A total of ninety (90) students were sampled for the study; that is thirty (30) students of each group (experimental & control). Each level was represented by thirty students; having fifteen (15) for experimental and (15) for control groups. The instrument for the sample was the Basic Science Achievement Test (BSAT) for testing the academic performance of Basic Science students across the levels both in experimental and control groups. The research design used was the t-test of independent variable to analyze the data collected for the study. The study found that the simulation technique was very much higher and better than those taught using the conventional method in the cause of lesson presentation in their respective classes. It was recommended among others that teachers should make effective use of simulation technique method in lesson delivery as it proves to be more promising in enhancing student's academic performance.

Methodology

This study adopted a non-randomized, control group, pre-test, post-test quasi-experimental design. The design is symbolically represented as follows: The Population for the Study involved all the three (3) Government-owned Model Secondary Schools in the Senatorial District with a population of three hundred and fifty-two (352) Junior Secondary Two (JSS2) students in 2019/2020 academic session (BSUBEB, 2021). The Sample for the Study was one hundred (100) JSS2 students which represent 28.41% of the total population purposively sampled from the entire population. Two instruments were used for this study; Basic Science Performance Test (BSPT) which tested the students' academic performance and Basic Science Retention Test (BSRT) which tested the students' retention level of the Basic Science concept with subjective tests consisting twenty (20) items. The data collected were analyzed using mean and standard deviation to answer research questions. The null hypotheses were tested using z-test and Analysis of covariance (ANCOVA) at 0.05 alpha levels.

Research and Analysis

Research Question 1

What is the effect of academic performance of Basic Science students taught using Computer Simulation approach and Lecture method?

Table 1: Analysis of Mean and Standard Deviation of Pre-test and Post-test scores of Students' Academic Performance using Computer Simulation Approach and Lecture Method

Treatment	No of students	Pre-test		Post-test		Mean Gain	% Gain
		Mean	SD	Mean	SD		
Computer Simulation Approach	50	49.27	8.38	73.80	9.05	24.53	49.79
Lecture Method	50	48.20	9.97	65.20	10.31	17.00	35.27

Table 1 showed the mean and standard deviation of students thought with computer simulation approach and those thought with lecture method. The table revealed that during the experimental group (computer simulation) group had (mean =73.80; SD= 9.05) and mean gain of 24.53 while the control group (lecture method) had (mean=65.20; SD=10.31) and a mean gain of 17.00 after the administration of the instrument. This implies that students perform better when computer simulation approach is used in teaching Basic Science than when lecture method is used.

Research Question 2: What is the level of retention ability of Basic Science students taught using computer simulation approach and lecture method?

Table 2: Mean and Standard Deviation of Retention Level scores of both Methods

Treatment	No of students	Post-test		Retention		Mean Loss	% Loss
		Mean	SD	Mean	SD		
Computer Simulation Approach	50	73.80	9.05	65.67	10.16	-8.13	-11.02
Lecture Method	50	65.20	10.31	52.53	12.97	-12.67	-19.43

Table 2 showed the mean and standard deviation of students' retention levels when thought with both methods. The table revealed that during the experimental group (computer simulation) group had (mean =65.67; SD= 10.16) and mean loss of -8.13 while the control group (lecture method) had (mean=52.53; SD=12.97) and a mean loss of 12.67 after the administration of the instrument. This implies that students retained higher when they are being thought with computer simulation approach than when discussion method is being used.

Hypotheses

Ho_1: There is no significant difference on Basic Science students' academic performance scores using computer simulation approach and lecture method.

Table 3: Summary of ANCOVA on Academic Performance scores based on Computer Simulation Approach and Lecture Method

Source of Variation	Type 3 Sum of Squares	Df	Mean Square	F	Sig
Corrected model	5295.633	3	1765.211	45.114	0.000
Intercept	4923.946	1	4923.946	125.843	0.000
Pre-test	4098.478	1	4098.478	104.746	0.000
Method	801.375	2	400.687	10.240	0.000
Error	3364.989	86	39.128		0.000
Total	294496.000	90			0.000
Corrected Total	8660.622	98			

Table 3 shows that there was significant different between the academic performance of students taught work and energy and Excretion in plant using computer simulation approach and lecture method (f2, 86 = 10.240, p<0.05). Hence the null hypothesis ($H0_1$) was rejected.

H_{O2}: There is no significant difference on Basic Science students' retention scores using computer simulation approach and lecture method.

Table 4: Summary of ANCOVA on Retention scores based on Computer Simulation Approach and lecture Method

Source of Variation	**Type 3 Sum of Squares**	**df**	**Mean Square**	**F**	**Sig**
Corrected model	3115.027	3	1038.342	6.599	0.000
Intercept	5035.121	1	5035.121	31.998	0.000
Pre-test	0.005	1	005	0.000	996
Method	2687.166	2	1343.583	8.538	0.000
Error	13532.795	86	157.358		
Total	214144.000	90			
Corrected Total	16647.522	98			

Table 4 shows that there was significant difference between the retention abilities of students taught work and energy and Excretion in plant using computer simulation approach and lecture method (F2, 86 = 8.538, p<.05). Hence the null hypothesis was rejected.

Conclusion

Computer simulations are software programs that either replicate or mimic real world phenomena. If implemented correctly, computer simulations can help students learn about technological events and processes that may otherwise be unattainable due to cost, feasibility, or safety. Studies have shown that computer simulators can be equally as effective as real life, hands-on laboratory experiences in teaching students scientific concepts, enhance the learning achievement levels of students and enhance the problem solving skills of students and foster peer interaction.

Recommendations

1. Teachers of Basic Science should adopt computer simulation approach in the teaching and learning of the subject in order to improve students' academic performance and retention level of the concepts. This is necessary because the method increases students' retention abilities.

2. Serving teachers should be trained and retrained on the job to improve on this innovative method of instruction. This can be done through seminars, conferences, workshops organized by both governmental and non-governmental agencies like the Science Teachers Association of Nigeria (STAN).

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