Full Length Research Paper

Effects of computer-based constructivist instruction on students' achievement and interest in biology

[1]Esther E. Ekon and *[2]Nkoyo B. Edem

[1/2]Univeristy of Calabar, Calabar
*Corresponding author's E-mail: nkyedem@gmail.com

Abstract

The study was aimed at comparing the effects of the constructivist instructional strategy supplemented by the use of textbooks and charts with a constructivist instructional model supplemented by a number of materials downloaded from the internet to determine which method facilitates greater learning. The sample of the study consisted of one hundred and thirty eight (138) senior secondary II (SS 2) students in Calabar South Local Government Area. Two instruments, namely, An Interest Inventory (AII) and Constructivist Biology Achievement Test (CBAT) developed by the researchers, were validated and used for the study. Two research questions and two null hypotheses guided the study; a non-equivalent, pretest-post quasi experimental design was employed. Two intact classes were used from two different schools purposively sampled, one as experimental and the other as the control group. The experimental group received treatment with the use of computer while the control group received treatment with the use of textbooks and charts. Independent t-test statistical analysis was used. The results indicated that, there was no significant difference in the mean achievement scores of both the control and experimental groups. However, there was a significant difference in the mean interest score in favour of the experimental group. The findings of this study implied that knowledge can easily be gained if the students are actively involved in the classroom and their interest in the subject is aroused. The researchers recommend among others that the use of activity-based, child-centred instructional methods like Computer-based Constructivist Approach or any other constructivist model should be used in the teaching of science subjects especially biology since it enhances better achievement and evokes the students' interest in biology. It was also recommended that the government should organize in–service training programmes and refresher courses to create awareness on the new instructional strategies and improve their competencies in helping students understand scientific concepts with ease. ICT has been integrated into the new curriculum in secondary schools, it was recommended also that the capacity of teachers needs be built up to meet up with this challenge; the government should therefore assist teachers to buy computers with internet facilities as well as sponsor their attendance to conferences and workshops that could update their knowledge in line with current demands.

Keywords: Constructivist instructional Strategy, Computer-based Constructivist Instructional Strategy, SS2 Students' Achievement and Interest in Biology, Cross River State, Nigeria.

INTRODUCTION

In Nigeria, according to the National Policy on Education, (2004) one of the main objectives of secondary education is to equip students to live effectively in modern age of science and technology. The implication of this objective is that science and technology provide the basic tools of industrialization, national development, economic and social development of the citizens.

Technology developed at an increasing rate in the

_____

*Corresponding Author: E-mail: nkyedem@gmail.com

Western Nations and other advanced countries but in Nigeria, the rate is slow though it is gradually coming up in recent times. Information Technology (IT) is present everywhere. However, the use of these tools in our teaching and learning environment is our concern and problem. The use of these tools in the world has broken the barrier of distance and made life easier. It requires one to press a button with a number and you speak with somebody as if the person is next to you, no matter the distance, with the use of Global System for Mobile Communication (GSM) popularly known as mobile phones. The Internet, the information superhighway, according to, Amoo and Rahman (2004), is a single telephone line that traverses the whole world, connecting several millions of computers and computer-based machines, equipments and tools that could give and receive information. Computer, according to Wersh (1998) is a tool, a vehicle for combining motor skills, language, images and symbolic manipulation through practical activities. The integration of these dynamic tools and its efficacy in our learning and teaching environment in this information age is the main focus of this paper.

The aim of science education, according to National Policy on Education (2004), is to inculcate into the learners creative abilities in order to live a self-reliant life in future. However, 'implementing these aims and objectives of science education in our secondary schools has not produced any significant change in students since they cannot pass examinations easily. Salau (1996) reported that unqualified teachers are employed to teach Biology and other Science related subjects. This type of teachers paints a blank future for the development of science education and the realization of technological progress in our country. Students who receive instruction from unqualified teachers in science certainly will perform below average in examinations.

The issue of underachievement has been a source of worry to parents, policy makers, examination bodies, teachers and the nation as a whole. Efforts have been made by several research bodies like STAN-Science Teachers' Association of Nigeria and individuals to avert this situation but they seem not to have yielded the desired results, judging from the current results published by Examination bodies like the West African Examination Council (WAEC) and the National Examination Council (NECO).

Research findings have shown that several factors militate against improved and effective academic achievement of our students in biology and other Science subjects. These include the application of wrong and. ineffective instructional strategies in our schools.

These seem not to help students acquire Science Process Skills that will enable them understand sci-entific concepts in order to excel in examinations, thereby limiting their ability to live self reliant lives in the society after graduation from secondary school. It is surprising that many Biology teachers still teach by the use or direct and "verbalized instruction" because it seems to be a shortcut to the goal of covering the Biology syllabus (Udeme-Obong, 2003). The other reason is the lack of awareness or unwillingness by teachers to try other available strategies that are known to be activity-oriented, collaborative, interactive and student-centred.

Amoo et al. (2004) asserted that students' attitude contribute to low achievement in science subjects. He stressed that poor achievement in science subjects makes a student exhibit a negative attitude towards the subject. Other researchers like Odo (95) and Akalonu (2001) attribute students' poor performance in biology to lack of interest in the subject. The conventional teaching methodology (Talk and chalk) used by teachers may not have been able to spur students' interest to learn the subject; after all, students seem to learn more effectively those things that appear to interest them.

In recent times, according to Nwosu and Nzewi (1998), the methods that are advocated for effective teaching and learning of science subjects include the use of analogy, inquiry, cooperative learning, problem-solving and constructivism. These strategies are activity and interactive oriented, thus help learners develop appropriate skills for better understanding of scientific concepts in the classroom, build their creative abilities, improve their self esteem and make them to be active participants in the classroom. These strategies not only help students learn and retain information, but also have positive effects on the students' attitudes towards studying science subjects. For the purpose of this paper, the researchers are restricted to discussing constructivism.

Constructivism is a teaching strategy, which holds the View that scientific knowledge be personally constructed and reconstructed by the learner based on his or her experience. It is a model of instruction, which allows for interaction between students/students, students/teacher in the classroom. It is a problem-solving approach to learning that allows students to explore and work in groups, making meaning of tasks and setting out to solving problems that are perplexing to them (Tim, 1993). There are several constructivist models, which are useful in helping learners reconstruct their knowledge based on their prior conception. They include:
1. The five phases of constructivist model (5E Model)
2. The five steps conceptual change model (PEDDA)
3. The four phases of constructivist model (IEPT)
4. The seven phases of constructivist model (7E Model)
5. Learning cycle model
6. Analogy
7. Negotiations

The Biological Science Curriculum Study (BSCS) cited in Mandor (2002) proposed that learning and teaching framework based on constructivism should consist of five phases namely Engagement, Exploration, Explanation, Elaboration and Evaluation.

Constructivism is an inquiry-based instructional approach that has been proven by many researchers such as Nworgu (1997), Nwosu and Nzewi (1998); Iloputaife (2000); Mandor (2002); and Eze (2005) to enhance achievement in science. It then becomes pertinent to explore its efficacy with the use of computer-based learning and ascertain whether or not learning can be done more effectively.

Freenberg (1999) advocated giving the students the maximum control over learning and creating curricula that foster growth and development of their minds. This can be achieved through the unique nature of new technologies such as computer and its accessories where it is intended to serve as a teaching, learning and problem-solving tool, with the ultimate objective of providing a level of instruction equivalent to or better than that of a human teacher (Dalal, 1992). The human ability to guide, encourage and reinforce positively is still a necessary component of teaching with computer-based learning because programme learning is critically dependent for its effectiveness on the design of the questions. However, some studies have been carried out including that by Baggot and Wright (1997), which showed no significant difference in cognitive achievement with the use of computer in education. There is paucity of literature on the effects of computer-based constructivist instruction on students' achievement and interest in Biology.

The purpose of this study therefore was to investigate the effects of the computer- based constructivist instruction on students' achievement and interest in Biology.

Research Question

1. To what extent does computer-based constructivist instruction affect students' achievement in Biology?
2. How does the computer-based constructivist instruction affect students' interest in Biology

Research Hypotheses

HO_1 There is no significant difference in the mean score of students taught Biology using Biological Science Curriculum Study Constructivist Model (BSCSCM) and those taught Biology using Computer-based Constructivist Approach (CCA).

$H0_2$ There is no significant difference in the mean interest score of students taught Biology using BSCSCM and those taught using computer-based Constructivist Approach (CCA). '

Research Design

The study employed quasi-experimental design where students in intact classes were used. The pre-test/ post-test non-equivalent control group was used. Both the experimental and the control groups were given pretest at the beginning of the experiment and post-test at the end of the experiment. The control group was given treatment with textbooks and charts while the experimental group was given treatment with the use of materials downloaded from the internet and copied into two computer systems.

Sample and Sampling Techniques

Two schools were purposively selected from the fourteen (14) Co-educational state owned secondary schools in Calabar South Local Government Area. An intact class in each of the schools was purposively assigned to experimental and control groups.

Instrumentation

Two instruments were used for the study: (1) An Interest Inventory (AII) adapted from Akalonu (2001) and a Constructivist Biology Achievement Test (CBAT) developed by the researchers. Experts validated the instruments alongside with the note of lessons written by the researchers. The reliability was established using Pearson Moment Correlation. The reliability estimates derived from the analyses were 0.875 and 0.945 respectively.

Procedure

The drawn sample was pretested before the treatment and after the treatment; the test was given to them as posttest. The Interest Inventory (AII) scale was also given to the students twice. In the school where there is school Net project, an intact class (68 students) that is exposed to computer training was used as the experimental group. My class was used as the control group (70 of them) where there is no school Net project. The students in the control group were taught the lesson using Biological Science Curriculum Study Constructivist Model

Table 1. Independent t-test analysis of the difference in achievement between students taught Biology with Biological Science Curriculum Study Constructivist Model (BSCSCM) and those taught Biology with Computer-based Constructivist Approach (CCA).

Variables	N	X	S.D.	T
students taught BSCSCM	70	12.2	2.44	
				0.515
students taught (CCA)	68	11.8	2.36	
Significant at .05 df = 136; Crit. T = 1.66.				

Table 2. Independent t-test analysis of the difference between interest score of students taught. Biology using BSCSCM and those taught using computer-based constructivist's model.

Variables	N	X	S.D.	T
Interest score of students taught	70	10.58	5.11	
				3.435
Interest score of students taught (CCA)	68	18.21	4.65	
Significant at .05; df = 13"6; Crit. T = 1.66.				

(BSCSCM). Cut-out pieces from cardboard paper made from drawings of the bones of the vertebral column and limbs of rabbit were given to them to work in groups. They were to identify the different bones on paper and place the cut-out pieces properly in their right positions using adhesive provided, to form the vertebral column of a mammal. They were provided with the cut-out pieces of the upper limb; with the help of strings, they lifted the hand to see the effects of the biceps and triceps muscles of the upper hand.

The researchers sensitized the computer instructor teaching the experimental group on the use of Biological Science Curriculum Study Constructivist Model (BSCSCM) to teach the topic with the computer. Instructional materials on skeletal systems and limbs of mammals were downloaded from the internet and copied into two computer systems present in the school for the students to browse after the class lesson. This was done because there is no software available on the topic. The study was conducted over 8 times with six students attached to one computer. The students, through the use of the mouse, visualized the skeletal system on the computer screen. They were to use the cursor and drag the different parts of the vertebral column and place them correctly on the body (image) of the rabbit on the screen. The students used the mouse also to lift the upper limb up and down to see the effects on the biceps and triceps muscles of the upper hand.

Assignment was given to the two groups to find out the number of lumbar and sacral vertebrae of a man in the textbook in case of the control and internet in the case of experimental group.

RESULTS AND DATA ANALYSIS

The results of the study are presented in the tables below:

Results of the analysis in Table 1 showed that the calculated t-value of 0.515 was less than the critical t-value of 1.660 at 0.05 level of significant with 136 degree of freedom. The hypothesis is upheld implying that there is no significant difference in achievement between students taught biology with BSCSCM and those taught biology with Computer-based Constructivist Approach (CCA).

Results of the analysis in Table 2 showed that the calculated t-value of 3.435 was greater than the critical t-value of 1.66 at 0.05 level of significant with 136 degree of freedom. The -hypothesis was rejected implying that there is a significant difference between interest score of students taught using CCA (Computer-based Constructivist Approach) and BSCSCM (Biological Science Curriculum Study Constructivists' Model).

RECOMMENDATION, IMPLICATION AND CONCLUSION

As a result of the findings from the study, the following

measures are recommended:

1. Practicing teachers in our secondary schools should be professionally trained and qualified to handle diversified curricula.
2. Teachers should be encouraged to apply instructional strategies that are students-centred and activity-oriented.
3. Students must be matured enough or cognitive ready to learn scientific concepts ¬before they are admitted in schools.
4. Teachers in secondary schools should be retrained periodically in order to create awareness of the efficacy of new instructional strategies and improve the teachers' competency in helping students understand scientific concepts.
5. Given the following shift from the present conventional teaching to the integration of the tools of ICT, the capacity of teachers in secondary schools needs to be built to meet up with this challenge.
6. Teachers should avail themselves of the opportunity to be computer literate so as to enhance effective teaching of scientific concepts when these facilities are available. The successful implementation of e-learning into our education system will depend on teachers' personal uses of ICT and e-learning, especially for accessing resources and professional development.
7. Science laboratories should be established fully or properly furnished with kits, computers and instructional software. Schools should also have access to internet facilities to enable students explore their environment and discover concepts, get information themselves in website.
8. Government should assist teachers by sponsoring or subsidizing their attendance to conferences, and workshops that they could update their instructional knowledge in line with current demands.
9. Teachers should also be given loan to buy computers and internet facilities should be given at a minimal cost.
10. The use of computers should be integrated and enforced in schools.
11. The government should encourage and empower teachers to participate in software and information technology development so that ROMs and diskettes can be produced in such a way that they can be updated from time to time to help teachers/students in their teaching and learning processes.

Implication

The results of these findings can assist policy makers, government, curriculum planners, research institutes in education and all those concerned with National Educational System in improving on the overall quality of Education in Nigeria. Teachers need to involve their students in the classroom actively. This will enable them obtained first hand information about events and better understanding of science concepts easily. The use of computers and internet facilities in schools will ease the problem of note writing and spooning students as if they are empty vessels on the part of the teachers and help the explore their environment on their own to gain knowledge and be interested in class activities on the part of the students. The stakeholders in education should utilize this information to choose a better method of instruction to be adopted in the teaching of Science subjects especially Biology in Nigeria.

Problems Envisaged

If computers are to be introduced in school laboratories for the teaching of Biology and any other science subject, the problem of manpower needs to be addressed for proper implementation of these tools. Amoo et al (2004), identified problems such as:

1. Lack of trained teachers in media method and material production.
2. Lack of computer literate teachers.
3. Lack of system engineers and techniques.
4. Lack of accommodation for a safe keep of the computer and internet facilities.

CONCLUSION

Computer-based constructivist instruction on students' achievement and interest is a knowledge management tool for educational and national development. It was specifically established based on the statistical analysis of the study; no significant difference exists in science (Biology) students' performance when taught with computer-based Constructivist Approach. However, students showed significant difference in interest when taught with CCA compared to the BSCSCM approach. The retention span and learning activities were greater with the use of computer. Therefore, Computer-based Constructivists' Approach to knowledge management is recommended.

REFERENCES

Akalonu GC (2001). Effects of Female Gender Friendly Curriculum Materials on Students' Achievement and Interest in Integrated Science. Unpublished M.E'd thesis, Faculty of Education, University of Nigeria, Nsukka.

Amoo A, Rahman MA (2004). Secondary School Students Attitudes to Learning of Mathematics in the world of information technology-implication of Mathematics Teachers. 45th Annual Conference Proceedings of Science Teachers Association of Nigeria. 329-333.

Baggot L, Wright N (1997). Computer based learning in an Irish secondary school-with particular reference to Biology downloaded from http://www.computing.dcuire/research/papeers/MCE/1999/2499.ps.

Dalal A (1992). Computer Based learning in an Irish secondary school - with particular reference to Biology downloaded from file: A: computer learning in an Irish secondary school-with particular reference to Biology. Retrieved 2/23/2008

Eze JU (2005). Science and teaching in secondary schools: capacity building strategies for enhancement journal of world council for curriculum instruction, Nigeria chapter forum 5 (2\265-271.

Freenberg (1999). Computer based learning in an Irish secondary school - with particular' reference to Biology. Retrieved from htt://www.computing.deu.ie/research/papers/MCE/1999 on 3/6/2008.

Mandor AK (2002). Effects of constructivist-based instructional model on acquisition of science process skills among junior secondary students. Unpublished M.ed thesis, Faculty of education, University of Nigeria, Nsukka.

Nworgu BG (1999). Post positivistic developments challenges to contemporary STM teacher education. A guest/special conference lecture on the occasion of the 1st Nation Conference organized by the Faculty of Education. ESUT.

Nwosu AA, Nzewi U (1998). Using the constructivist model to communicate science. 39th Annual Conference Proceedings of Science Teachers Association of Nigeria. 349-353.

Salmt MD (1996). A. survey of the qualifications of Nigerian Secondary Schools Science and Mathematics teachers. J. Sci. Teaching and Learning 2 (1):37-45.

Udeme-Obong A (2003). Effects of Individual group and whole-class project teaching methods on senior secondary' students performance in Biology. Unpublished Master's thesis. University of Uyo, Uyo.

Wersh O (1989). Learning theory and e-padagogy 'downloaded from' http://www.,virtuallearnin org.uk/changmanage/pedagogy-practice. Retieved 3/6/2008.