

THE EFFICACY OF INNOVATIVE INSTRUCTIONAL TECHNIQUE FOR SCIENCE TEACHING AND LEARNING IN SECONDARY SCHOOLS

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Abstract

This paper discussed education, curriculum issues and evidence of declining performance of secondary school students. Emphasizes on new technologies to meet the challenges of the 21st century were also made. The efficacy of authors- developed instructional package (CAI) for teaching science concepts was determined using Pretest - Posttest Experimental group design. The reliability coefficient of CAI was 0.84. Eighty (40 males and 40 females) SS 1 students from two secondary schools in Minna Metropolis made-up the sample. The schools were randomly assigned to experimental and control groups. The experimental group was taught selected concepts of ecology using CAI and traditional method was used for the control group. Results revealed that the students taught with CAI performed better ($t=6.86$, $df=TS$, $P<0.05$) than the control group. The CAI was found also to be gender friendly ($t=1.05$, $df=38$, $P>0.05$). Based on the findings, recommendations were made.

Introduction

The essence of education worldwide is to assist individuals to maximize their potentials for optimal, self and national development. Indeed, education generally is not only profitable, but a prerequisite for meaningful and sustained national economy. No nation can rise above the quality of its educated citizenry. Secondary education dictates the pace of education at the primary and tertiary levels. It consumes the products of the primary schools on the one hand, and yields input for the tertiary level on the other, Secondary

education is very important in the future growth of an individual and the nation. The teacher, at whatever level of education, is the pivot of learning. In a typical lesson, an effective teacher normally uses more than one method. The instructional method employed by the teacher plays an important role in the acquisition of skills and meaningful learning. Huge and giant strides which countries like Japan, Thailand, Singapore and others, achieved in technology, economic empowerment and self reliance can be attributed to (among others), effective teaching and learning. The importance of education and mode of instruction cannot be over-emphasized in this era of Science, Technology and Mathematics, driven by ICT.

However, the picture today is that education is falling, the results of Senior Secondary School Certificate Examination of students in Nigeria as shown on Table 1 are highly disturbing, considering the fact that the product would form future undergraduates and leaders. If educational efforts are indeed failing us, the presupposition on which these efforts have been founded (methodology) must be questioned. Several factors singly or in combination are implicated in the poor performances of students, failure in education, and the ability to be self-reliant or secure job. The facts are;

- * Resistance to change: In some schools teachers have adopted ICT like power point slides and internet browsing, but are unwilling to adopt computer based instructional innovations.
- * Youths seem to be more inclined to business and quick money making ventures .
- * Effective teaching methods are not implemented as claimed by (Tolu, 2009).
- * Traditional method is still predominantly used in schools (Yusuf & Afolabi, 2010).
- * New technologies are not used .
- * Students tend to consider each topic as an isolated event, while the teachers assume that the connecting link has been made.

Table 1: Percentage performance of students in MAY/JUNE WASSCE, 2005-2009 in Nigeria at credit level and above

Year	Bio	Chem	Econs	Eng	Math	Phys
2005	35.74	50.94	36.24	25.64	38.20	41.53
2006	49.23	44.90	49.44	32.48	41.12	58.02
2007	33.37	45.96	39.03	30.32	46.75	43.19
2008	33.94	44.44	49.22	34.02	57.27	48.26
2009	28.58	43.69	45.44	41.52	47.04	47.83

Source: WAEC, /Lagos, Nigeria (2005 - 2009)

It is clear that a wide gulf exists between expected and observed educational outcomes. From research evidence, educators see the pressing need to reconsider the techniques and method of instruction. To address these challenges and issues, there is need for instructional system and support of technology to give consideration to meaningful learning.

Today, there is unprecedented quest for functional education globally. There appears to be a paradigmic shift towards technology, driven by a built-in knowledge and information management, new contents and curriculum materials used to achieve the national goals. The relationship of classroom methodology and performance is an issue that concerns the whole curriculum. The curriculum of the 21st century is student-centred with innovative teaching and learning methods integrated with technology and elements of problem-solving. The world has moved to the electronic stage with computer at the centre. This development has brought a lot of innovation and revolution into teaching and learning. Computers have been found to be effective device for presenting instruction using different softwares. Research reports have shown that computer technology has been associated with improvement in education-performance, labour market prospects and everyday living. (Tolu, 2009; Mohammed, 2006; Hart, 2006; Aldahmash, 1995; Varghese, 1996). Many innovative instructional technologies are available today; one of the most significant is Computer Based Instruction (CBI) which is synonymous with Computer Assisted Instruction (CAI). Major advantages are that students can progress at a rate comfortable to them, and they can access educational details easily. In its application, computer based learning can be used to complement other traditional modes of

instruction. Other advantages of the new technologies in instruction are that they make learning interesting and exciting. Because students are motivated to participate, it affects wider range of stimulus, it provides alternate ways to learning suitable to the youths who are quite comfortable in navigating the virtual world. The psychological theories of Piaget, Bruner and Ausubel lent support to Computer Assisted Instruction. Piaget described it as "equilibrium of learning".

Research findings in gender have been inconclusive. The results of Tolu (2009) and Umar (2011) revealed that there is no significant difference in the performance of male and female students in science concepts, while the findings of Iwendi (2009) and Kuta (2010) reported that male students performed better than their female counterpart, in science and mathematics concepts. Instructional technology, such as CAI in learning, is fast gaining ground. The aim of this paper is to report the result of a study carried out in Nigeria using author-developed CAI with animation, and its efficacy in teaching and learning.

Objectives

The objectives of this research are to:

- i. Develop and validate the Computer Assisted Instructional Package.
- ii Determine the efficacy of CAI (in improving learning and understanding of science concepts) and its effect on male and female secondary school students.

Research Questions

- (i) How do achievements of students taught Ecological concept using CAI differ from their counterparts in the control group?
- (ii) Is there any difference in the achievements of male and female students taught Ecological concepts, using CAI?

Research Hypotheses

- H₀₁: There is no significant difference between the mean achievement scores of students exposed to CAI and their counterparts in the control group.
- H₀₂: There is no significant gender influence on the performance of students taught using CAI in ecological concepts and the control group.

Methodology

The research design adopted for the study is Pretest-Posttest experimental group design.

Two levels of independent primary variable (one treatment and a control), two levels of gender (male and female) were investigated on students' performance in Biology. The design layout is as shown in Table 2.

Table 2: Research design layout

Groups	Pretest	Treatment	Posttest
Experiment	O1	Animation	O2
Control	O3	Conventional method	O4

Based on the nature of this research, three stage sampling techniques were adopted. Firstly, stratified random sampling procedure was adopted to obtain two Secondary schools in Minna Metropolis, Niger State Nigeria. These schools were sampled based on (Laboratories facilities and manpower), school type (public schools), gender composition (coeducational schools). The two schools were randomly assigned to experimental group (CAI group) and control group (traditional teaching methods) respectively. Finally, stratified sampling technique was used to select the 80 SS (students). The experimental group had 40 (22 male - 18 female) students and control 40 (20 male - 20 female) students.

A Computer Assisted Instructional Package (CAI) was developed for this study. The package consisted of four topics in ecology: Ecosystem, food chain, food web, feeding relationship among living organism in an ecosystem, and local biomes in Nigeria. The necessity for researcher-made computer package was based on the fact that the commercially produced computer-assisted instructional packages are not common. Even if they were available, they may not be directly relevant to the topic or objectives to be achieved in this study. As result of this, developing a computer package for use by the researcher was inevitable.

The computer Assisted Instructional package (CAI) with the ecological content was installed in the system. The computer presents information and displays animation to the learner on each of the units after which the students assessed themselves with objective questions at the end of each unit. The students could only proceed to the next unit, if they satisfactorily answered the questions. When a student fails a question, the computer package will give a remedial lesson on that particular concept or question until the student is able to master the concept, then he or she moves to the next unit.

The instrument that was used in collecting data for the study was the researcher-adopted

Ecology Achievement Test (EAT). The Ecology Achievement Test (EAT) consisted of 40 multiple choice objective items with five options (A-E) adopted from past examinations of West African Examination Council (WAEC, May/June) and National Examination Council (NECO, June/July). EAT was validated by experts in Biology, computer and evaluation and its reliability coefficient determined as 0.84 using Kuder Richardson (KR-21).

The study was for twelve weeks. The objectives and the modalities of the experiments were specified and operational guide was produced before the commencement of the treatment. The researcher administered the Ecology Achievement Test (EAT) on sample students, as pretest to ascertain the equivalence of the students before the treatment. Treatment was followed immediately, thereafter EAT was administered as posttest to measure the achievement of the sample students in each school. The scores obtained were subjected to data analysis. The data were analyzed based on the stated hypotheses, using mean, standard deviation and t- test. The significance of the various statistical analyses was ascertained at the 0.05 alpha level.

Results and Discussion

The results are presented in line with the formulated hypotheses:

H01: There is no significant difference between the mean achievement scores of students exposed to CAI and their counterparts in the control group.

In order to test this hypothesis, t-test was used to analyze the mean scores. The summary of this analysis is shown on table. 3.

Table 3: Analysis of the mean achievement scores of experimental and control groups

Group	\bar{X}	N	SD	df	t-value	P
Animation	55.27	40	11.38	78	6.86*	0.01
Control	48.00	40	10.58			

*Significant at $P < .05$

The table 3: presents the t-test of experimental and control group, the mean score of the experimental group was 55.27 and 48.00 for the control. The calculated t-value of 6.86 was significant at the 0.05 level. This indicates that there is statistically significant difference between the experimental and control group ($t=6.86$, $df=78$, $P=0.01$). Hence, the null hypothesis one (H_0) was rejected, indicating that there is a significant difference in the mean scores of experimental and control group

H₀₂: There is no significant gender influence on the performance of students taught using computer animation in ecological concepts;
 To test this hypothesis, t-test statistic was also used to analyze the mean scores. The summary of this analysis is shown on table 4.

Table 4: t-test analysis on achievement scores of male and female students exposed to CAI

Gender	N	\bar{X}	SD	df	t-value	P
Male	18	56.00	7.52	38	1.05	0.10
Female	22	54.55	11.74			

ns= not significant $P > .05$

Table 4 presents the t-test of male and female students of experimental group. The mean scores of the male students were 56.00 and 54.55 for the females. The calculated t-value of 1.05 was not significant at the 0.05 level. This indicates that there is statistically no significant difference between the male and female students taught with CAI, (t=1.05,df=38,P=0.10). Hence, H₀₂ was upheld. Therefore, there is no significant difference between male and female students taught with computer animation package.

Discussion on the Results

The result of hypothesis one reveals that there is significant difference in the learning achievements in favour of the group taught ecological concept with computer animation. This result agrees with the findings of Tolu (2009) in biology, Mohammed (2006) in visual art education and Hart (2006) in foundation of graphics which confirmed that computer animation has been effective in enhancing students' performance than the contional classroom instruction.

Similarly, this finding draws support from Aldahmash (1995) and Varghese (1996) chemistry who concluded that computer animation increases academic performance than conventional method. The higher achievement by the experimental group could be attributed to the novel nature of CAI in the Nigerian school setting, hence was able to captivate the attention of the students.

The result of hypothesis two shows that there is no gender effect on the achievement of male and female students taught ecological concepts with CAI. This finding is in agreement with the results of Tolu, (2009) and Umar (2011), which revealed that there was no significant difference in the performance of male and female students in science

concepts. Therefore, gender has no effect on students' academic performance when taught with CAI.

Conclusion

The paper has critically examined education and its problems, especially within the secondary school level, in a rapidly changing world. It is the view of the authors that there is still a wide gulf to be bridged in the area of teaching and learning. The innovative technology using CAI seems to be the answer. Computer Assisted Instruction with animation was more effective in teaching the biological concept of ecology than lack of CAI, and is also gender friendly.

Recommendations

We are in a world that is in a space age and therefore schools and educators are expected to be in the vanguard to propel it in the right direction. It is recommended that teachers should be ICT compliant in order to cope with current trends in pedagogical practices and institutional needs to expand their network. Science teachers should be trained on the effective use of Computer for instruction through seminars, workshops and conferences.

References

- Aldahmash, A.H. (1995). Kinetic vs. Static Computer-Generated Visuals for Facilitating College Students' Understanding of Reaction Mechanisms in Organic Chemistry. Doctoral dissertation, University of Oklahoma. Dissertation Abstracts International, 56, no. 08A(1995): 3069. (UMI Number: AAI9542129).
- Doymus, K. (2008). Teaching chemical equilibrium with the jigsaw technique. *Research in Science Education*, 38(2), 49-260.
- Gambari, A. I. (2010). Effectiveness of computer-assisted instructional package in cooperative settings on senior secondary school students' performance in physics, in Minna. Unpublished PhD dissertation University of Ilorin, Nigeria
- Hart, W. J. (2006). The impact of Computer Animation Learning toward student academic Performance, Thesis submitted to the Graduate Faculty of North Carolina State University.
- Iwendi, B. C. (2009). The influence of gender and age on the mathematics achievement of secondary school students in Minna metropolis, Niger State. Unpublished M.Tech. Thesis, Science Education Dept. Federal University of Technology, Minna, Nigeria.
- Kuta, I. I. (2010). Effects of local resources on learning achievement and retention Among secondary school biology students. Unpublished M.Tech thesis Federal University of Technology (FUT), Minna, Niger State.
- Mohammed, K. R. (2006): The impact of computer animation learning toward Students academic performance on art and design education program. Unpublished M. A thesis, Faculty of Education, University of Tech, Mara.
- Tolu, O. T. (2009). Effects of computer animation and instruction model on the Performance of students in senior secondary students biology in Minna. Niger State, Nigeria. Unpublished Bachelor of Technology, (B, Tech) Project. Department of Science Education, Federal University of Technology, Minna, Nigeria
- Umar, A. A. (2011). Effects of biology practical activities on students process skills Acquisition in Minna Niger state. *Journal of Science, Technology, Mathematics*

and Education (JOSMED), 7 (2), 10-22

Varghese, V. (1996) "Visualization of Stereochemistry: The Comparison of Computer-Animated, Hand-Held, and Two-Dimensional Representations of Molecular Models." Doctoral dissertation, The University of Oklahoma Dissertation Abstracts International. 57, no. IIB (1996): 6958. (UMI Number: AAG9712663).

Yusuf, M. O. & Afolabi, A. O. (2010). Effects of computer assisted instruction (CAI) on secondary school students' performance in biology. The Turkish Online Journal of Educational Technology. 9(1). Retrieved on the 15th January, 2010 From <http://www.tojet.edu.com>