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A comparative study of the effects of computer-based animation program and charts on secondary school students' understanding of cell division in Obio/Akpor local government area of rivers state

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Abstract
This study investigated the effects of Computer-based Animation Program and Charts on secondary school students' understanding of cell division, a concept in Biology in Obio/Akpor Local Government Area of Rivers State. The study was a quasi-experimental study that adopted pre-test posttest control group design. Three research questions and three hypotheses guided the study. The sample consisted of 160 SS2 Biology students selected from four Senior Secondary Schools purposively but randomly assigned to experimental and control group. Data were obtained through a 30-item multiple choice Biology Performance Test and an attitude questionnaire. The instruments were validated by experts and reliability coefficients of 0.85 and 0.76 were respectively obtained through test-retest method. Mean and Analysis of Covariance were the statistical tools for data analysis. Findings of the study showed that, Computer-Based Animation Program enhanced students' performance (understanding) more than the use of Charts. No significant difference in performance was found between male and female students taught Cell division with Computer-Based Animation Program. Also students' attitude towards Biology was found to affect their performances. Those with positive attitude towards Biology performed better than those with negative attitude to Biology. It was therefore recommended among other things, that the use of Computer-Based Animation Program and other forms of Computer Assisted Instruction be incorporated into Senior Secondary School Biology Syllabus.

Keywords: computer-based animation, secondary school students, biology syllabus

Introduction

The educational system throughout the world is fast changing in response to socio-economic and technological demands. One of such changes is in the area of teaching techniques and methodology which until now has been teacher - centered. Teaching and learning processes have gone through series of changes over the years and have now been enriched with new methods and techniques which differ from the traditional chalk board approach, (Onasanya, Fakomogbon, Shehu & Soetan, 2010) [8]. The essence of these changes is to improve students' performance. One of the major changes is in the use of Computer in teaching.

The use of Computer has dominated human activities especially in the last two decades. Its use is complemented by a whole lot of other electronic devices, all of which are now collectively regarded as the Information and Communication Technology (ICT) (Oloyede & Olorundare, 2009) [7]. Consequently the first item that comes to mind when ICT is mentioned is the Computer. The global adaptation of the Computer has been the landmark of the educational system in the last two decades. This global adaptation of the Computer (ICT) in education has been premised on the potential of this new technological tool to change the educational system and better prepare the students and the average citizens for the information age and also accelerate national development efforts (Albirin, 2006) [1].

The Federal Government of Nigeria has initiated policies aimed at ensuring that Nigeria is not left out in the global drive towards the use of ICT in enhancing education and national development. One of such policies is the development of the ministerial initiative on e-learning in the educational system by the Federal Ministry of Education in 2004 (Federal Republic of Nigeria, 2004) [2]. To this end, the Federal Government has created a Ministry of Information Technology to further boost her policy.

The best example of the integration of science and technology into education according to Serin (2011) [11] is the use of Computer-Based Instruction. The use of Computers in the teaching and learning activities is defined as Computer-Based Instruction (CBI). The use of computers in teaching, in this way, enables the students to learn by self-evaluation and reflecting on their learning process. CBI motivates children to learn better by providing them with the immediate feedback and reinforcement and by creating an exciting and interesting game-like atmosphere. The studies in this field reveal that the students' achievements increase when the CBI technique is provided as a supplement to the classroom education.

Computer-Based teaching has had an impact on the development of the educational technology to a great extent in the 21st century and this has resulted in the production of the software for the Computer-Based Instruction. The primary purpose of the science education software is to solve the learning problems in the science courses encountered by students, to increase their motivation and achievements and to protect them against the negative effects of the rote-memory based educational system (Serin, 2011) [11]. According to Newton and Rogers (2001) [6], the importance of using Computer in science teaching and learning include the release

from laborious processes, expediting and enhancing work production, increasing currency and scope of reference and supporting exploration and experimentation, fostering self-regulated and collaborative learning, improving motivation and engagement, increasing pupils persistence and participation, improving students' understanding and perception. Every school subject, including Biology can be taught using ICT to achieve the aims and objectives intended.

The aim of Biology education, for instance, is two dimensional: serving the individual, and serving the society. The gains derived by the society from Biology education include human population control, food production, genetic control of breeding of more productive varieties of plants and animals and control of diseases, smoking and drug addiction (Onasanya *et al*, 2010) [8]. Thus the teaching of Biology especially Cell division in our schools cannot therefore be over emphasized.

From written literature, the teaching and learning of Cell division in school Biology can be handled using slide presentation, video presentation process, simulation and animation programs and other interactive Computer-Based software facilities in which a student interacts with and is guided by visual equipment aimed at achieving certain instructional goals (Ndirangu, 2006) [5]. The use of ICT-program promotes realism in incorporating movement and colours. This is because this program is capable of incorporating a model of a process, phenomenon or system thereby providing a framework for students to see the process as it is, this leads to proper understanding of the process (Kiboss & Oguniyi, 2005) [3].

While this type of electronic instructional systems have been successfully incorporated into the classroom and applied in the teaching and learning of various subjects with promising results in other countries, not much has been done in this regard in the case of Biology in Nigeria and other developing countries. However, studies conducted by Ndirangu (2006) [5]; Yusuf and Afolabi (2010) [12], Mbaeze, Ukwando and Anudu (2010) [4] and Onwusu, *et al*. (2010) [10] have all indicated that ICT imparts on students' academic performances. This study therefore is aimed at investigating the effect of Computer-Based Animation Program on students' performance with respect to understanding Biology particularly the concept of Cell division in secondary schools in Obio/Akpor Local Government Area of Rivers State.

Consequently, the following objectives which were transformed into research questions and subsequently converted to hypotheses guided the study.

Objectives of the study

1. To compare the students' understanding of the concept of Cell division when taught using Computer-based Animation Program with those taught using Charts.
2. To investigate the performances of male and female students taught Cell division using Computer-based Animation Program with those taught using Chart, with respect to their understanding of the concept.
3. To ascertain the understanding of students in Cell division when taught using Computer-based Animation Program and when taught using Chart given their attitude to Biology.

Research questions

1. What difference exists between students taught the concept of Cell division using Computer-based Animation Program and those taught using Chart, with respect to their understanding of the concept?
2. What is the effect of teaching method (Computer-based Animation Program and Chart) on the understanding of Cell-division by male and female students?
3. What difference exists between the understanding of the concept of Cell division by students taught with Computer-based Animation Program and those taught using Chart given their attitude to Biology?

Research hypotheses

HO_1: There is no significant difference in the understanding of the concept of Cell division by students taught using Computer-based Animation Program and those taught using Chart.

HO_2: Male and female students do not differ significantly in their understanding of Cell division when taught using Computer-based Animation Program and Chart.

HO_3: There is no significant difference between the understanding of Cell division by students taught using Computer-based Animation Program and those taught using Chart, considering their attitude towards Biology.

Methodology

The study was a quasi-experimental study which adopted the pre-test posttest control group experimental design. The structure of the design was such that; Problem-solving Approach with Computer-Based Animation Program and Chart served as independent variables while students' gender and attitudes towards Biology (Cell division) serve as moderating variables. Students' performance in the test administered served as measures of understanding (dependent variable). Furthermore, students in the experimental group were taught with Computer-Based Animation Program while those in the control group were taught with Charts.

The sample for the study consisted of 160 Senior Secondary (SS) 2 Biology students (male and female) from four public co-educational Schools purposively selected from the schools in Obio/Akpor LGA of Rivers State. Two instruments, the Biology Performance Test (BPT) and Biology Attitude Questionnaire (BAO) constructed and developed by the researcher were used to gather the relevant data for the study. The BPT consisted of 30-item multiple choice test questions, and had reliability coefficient of 0.85 via test-retest method after the application of Pearson Product Moment Correlation Technique as a measure of it stability over time. The Biology Attitude Questionnaire (BAQ) on the other hand consisted of 20-items statements, designed on a four point Likert scale eliciting students' attitude to Biology. The BAQ had a reliability coefficient of 0.76 obtained through the same process for BPT.

Prior to the commencement of the treatment and administration of the instruments, the teachers were given an intensive orientation on the use of the Computer-Based Animation Program, the researcher's notes of lesson and the students' learning tasks for the period of the treatment. Paper

colours and item numbers were different for the pre-test and posttest. Mean and Analysis of Covariance (ANCOVA) were the statistical tools employed for answering the research questions and testing of the hypotheses respectively.

Results

Research question 1

What difference exists between students taught the concept of Cell division using Computer-based Animation Program and those taught using Chart, with respect to their understanding of the concept?

HO_1: There is no significant difference in the understanding of the concept of Cell division by students taught using Computer-based Animation Program and those taught using Chart.

In Table 1 the posttest mean score for students in the experimental group, was 47.33, with a gain in mean of 34.23. While for the control group it was 29.80 with a mean gain of 16.52. This shows that the use of Computer-Based Animations Program in learning Cell division enhances students' understanding of the concept more than the use of Chart.

Table 1: Mean performances of students' understanding of Cell division and ANCOVA summary

Group	N	Mean		Gain score
		Pre-test	Post test	
Experimental group (Using Computer- based Animation)	80	13.10	47.33	34.23
Control group (Using chart)	80	13.28	29.80	16.52

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig
Corrected	12378.65	6	2063.11	72.55	S
Model					
Pretest	93.62	5	18.72	0.66	Ns
Methods	12095.85	1	12095.85	425.37	S
Error	4350.73	153	28.44		
Corrected	16729.38	159			
Total					

On further statistical analysis via ANCOVA the calculated $F_{(1,153)}$ value was 425.37 which was significant at a probability level of 0.05. Therefore, the state null hypothesis was rejected. The result is that there is significant difference in the understanding of the concept of Cell division by students taught using Computer-based Animation Program and those taught using Chart in favour of those in the experimental group (Computer-based Animation Program).

Research question 2

What is the effect of teaching method (Computer-based Animation Program and Chart) on the understanding of Cell-division by male and female students?

HO_2: Male and female students do not differ significantly in their understanding of Cell division when taught using Computer-based Animation Program and Chart.

Table 2: Mean performances of male and female students' understanding of Cell division and ANCOVA summary

Group	Experimental (Computer-Based Animation Program)				Control (Use of Chart)			
Gender	N	Pre-test	Post test	Mean Gain	N	Pre-test	Post test	Mean Gain
Male	40	13.40	48.10	34.70	40	13.30	30.30	17.00
Female	40	12.90	46.60	33.70	40	13.30	29.30	16.00

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Model	12396.38	6	2066.063	72.95	
Pretest	5.09	1	5.09	0.18	Ns
Methods	717.38	1	717.38	25.33	S
Gender	15.89	1	15.89	0.56	Ns
Interactions					
First order	3.52	1	3.52	0.12	Ns
Methods * Gender					
Error	4332.99	153	28.32		
Corrected Total	16729.38	159			

Table 2 revealed that in the experimental group, the male students' had posttest mean score was 48.10 while that of their female counterpart was 46.60. In the control group, male students' posttest mean score was 30.30 while that of their female counterpart was 29.30. These results showed that the male students performed better than the female students in both the control and experimental groups. In addition, calculated $F_{(1, 153)}$ value was 25.33, significant at probability level of 0.05. Gender was not significant since it's calculated $F_{(1, 153)} = 0.56$, $p > 0.05$ level of significance. Therefore, the stated hypothesis is hereby accepted. The result is that, male and female students do not differ significantly in their understanding of Cell division when taught using Computer-based Animation Program and Chart. The interaction of

Method and Gender was also not significant since its calculated $F_{(1, 153)}$ value was 0.12, $p > 0.05$ level of significance.

Research question 3

What difference exists between the understanding of the concept of Cell division by students taught with Computer-based Animation Program and those taught using Chart given their attitude to Biology?

HO_3: There is no significant difference between the understanding of Cell division by students taught using Computer-based Animation Program and those taught using Chart, considering their attitude towards Biology.

Table 3: Mean performances of students' understanding of Cell division in experimental and control groups classified by their attitude to Biology and ANCOVA summary

Groups	Attitude	N	Pre-test	Post test	Mean Gain
Experimental	Positive	54	13.22	49.11	35.89
	Negative	26	12.90	43.62	30.72
Control	Positive	56	14.28	31.07	16.79
	Negative	24	10.90	26.83	15.93

Source of Variation	Sum of Squares	df	Mean square	F	Sig.
Corrected	19381.29	7	2768.76	52.68	
Model					
Pretest	336.48	1	336.48	6.40	Ns
Methods	15.48	1	15.48	0.29	S
Attitude	307.66	1	307.66	5.85	S
Interactions					
Methods* Attitude	18.62	1	18.62	0.35	Ns
Error	16396.56	312	52.55		
Corrected Total	35777.85	319			

From Table 3, in the experimental group, the posttest mean score for students with positive attitude was 49.11 with a gain in mean score of 35.89, while those with negative attitude had a posttest mean score of 43.62, gain in mean score of 30.72. In the control group (use of Chart), the posttest mean score for students with positive attitude was 31.07 with a gain in mean score of 16.79, while those with negative attitude, had posttest mean score of 26.83, with a gain in mean of 15.93. This shows that in both control and experimental group, students with positive attitude performed better than those with negative attitude in terms of their understanding of the concept.

The ANCOVA analysis on Table 3 shows that the main effect of Method is significant since its calculated F (1, 312) value of 0.29 had a probability (p) value that was less than 0.05. Attitude of students towards Biology was also significant, calculated $F (1, 312) = 5.85$, $P < 0.05$ probability level. This shows that there is significant difference in the effect of attitude on students' understanding of the concepts of cell division when taught with Computer- Based Animation Program and when taught with Chart in favour of Computer-Based Animation Program.

Discussion of findings

One of the major findings of this study was that the use of Computer-Based Animation Program in teaching Cell division facilitates students' understanding of the concepts of Cell division more than the use of Chart. This could be attributed to the fact that the use of Computer Animations presents the facts (as/real life situations more than the use of Chart. The introduction of motion and sounds in Computer-Based Animations presents the facts close to the real life situation giving students a clearer View and understanding of the concept than the use of Charts.

This finding is in consonance with the previous studies of Onasanya, *et al*. (2010) [8] and Serin (2011) [11], whose works revealed that the use of Computer Assisted Instruction in teaching enhanced students' academic performance in Biology more than the use of the conventional method.

This finding is at variance with the findings of Mbaeze, Ukwando and Anudu (2010) [4] and Onwusu, *et al*. (2010) [10] that showed no significant difference between the performance of students taught with Information and Communication Technology (ICT) and those taught using the conventional method.

Another major finding of this research work is that there is no significant difference between the academic performance (understanding) of male and female students taught Cell division using a Computer-based Animation Program and those taught with Charts. This could be attributed to the fact that Computer-Based Animation Programs a subset of Computer Assisted Instructions have the capacity to engage, motivate and enhance the performance of male and female students alike. Though more research need to be carried out to confirm this.

This finding is in consonance with the position of Onasanya, Darammola and Asuquo (2006) [9], Ndirangu (2006) [5], and Yusuf and Afolabi (2010) [12] whose research findings revealed that there is no significant difference between the performance of male and female students exposed to the use of Computer Assisted Instruction. This result contradicts the findings of (Novak & Mosunda; Okeke & Ochuba; and Danmole,) all cited in Yusuf and Afolabi (2010) [12] whose work revealed that male students performed better than their female counterpart when exposed to Computer Assisted Instructions.

On the issue of attitude towards Biology, the analysed data

showed that students with positive attitude to Biology performed better than those with negative attitude in both control and experimental groups; those in experimental group had higher gain in mean than those in the control group. Again, students with negative attitude in the experimental group had high gain in mean than those in the control group. This showed that the use of the Computer- based Animation Program significantly improved students' understanding of Cell division, even the students with negative attitude towards Biology. This could be accounted for by the fact that the use of Computer Assisted Instruction is said to enhance students' understanding and interest more than the use of other methods.

This is in line with the findings of (Ndirangu, 2006 and Serin, 2011) [5, 11] whose research works showed that students' attitude influences their performance and the use of Computer-Based Animation Program which is a Computer Assisted Instructional technique enhance students' participation, motivation, interest and performance in learning.

Conclusion and recommendations

Based on the findings of this study, it can be concluded that the use of Computer-Based Animation Program could be an effective instructional strategy capable of enhancing both male and female students' interest and academic performances in Biology. Thus, the following are recommended:

1. Curriculum designers and developers should incorporate the use of Computer-based Animation Program, Computer Assisted Instructions and the use of Information and Communication Technology into Senior Secondary School Biology syllabus.
2. Since both male and female students performed better in the use of Computer-base Animation Program than in the use of Chart learning efforts should be directed towards intensive teacher - programs in Computer based learning.

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