



Effects of computer-based animation program and charts on students' performance in the application of the concept of cell division in secondary school biology

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Abstract

This study investigated the effects of Computer-Based Animation Program and Charts on students' performance in the application of the concept of cell division in secondary school 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 20-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 (application) 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 program, cell division

Introduction

Biology Education is concerned among other things with the acquisition of appropriate scientific and technological skills, attitude and knowledge necessary to cope with the challenges presented by the evolving health needs of modern times. Ndioho (2014) ^[6] remarked that the brain is not passive consumer of information. Therefore, for the purpose learning to be effectively understood, it requires the learner to consciously construct meaning of what to be learned. In an attempt to help students learn, understand and apply learnt information concerning Biology contents, several approaches have been employed. Among such approaches are; collaborative approach, explorative approach, inquiry and discovery approach, constructivist approach, and laboratory approach. Others include; concept mapping, demonstration method, discussion method, project method, didactic method, field trip/excursion, process approach, individualization method and more recently the use of Information and Communication Technology (ICT) i.e. Computer aided instruction.

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 and Olorundare (2009) ^[9].

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].

Little wonder in the constructivist environment, the student is considered to be the one in the centre of the learning process, the one who constructs knowledge and meaning linking new knowledge and information to existing knowledge (Ndioho, 2014) ^[6]. The teacher provides or facilitates the environment for relevant learning by creating whole, authentic, inherently interesting activities and by setting up multiple representations of reality and actual experience for students, thus enabling them to construct their own knowledge. Typical activities for such an environment are discussion, collaboration, negotiation, drawing, manipulating computer simulation, making graphs et cetera.

To this end, 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) ^[3]. Recently, 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 according to Serin (2011) ^[12] is the 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 students' achievements increase when the CBI technique is provided as a supplement to the classroom education (Owusu, Monney, Appiah, & Wilmot, 2010) ^[11].

The potential benefits of Computer Assisted Instruction (CAI) cannot be underestimated in the contemporary world. There is a list of established findings on the instructional value of computer, particularly in other parts of the world. Some of these findings included those of Serin (2011) ^[12]; Yusuf and Afolabi (2010) ^[13]; Ndirangu (2006) ^[7]; Mill (2001) ^[5]; Okoro and Etukudo (2001) ^[8]; Cotton (1997) ^[2] et cetera.

For Biology Education, ICT is of great value to the teaching and learning process. Computer simulation program provides Biology teachers with engaging lesson ideas that are specially designed to help students apply, understand and retain the difficult concepts of Biology, for example mitosis, meiosis (cell division), genetics, evolution, transportation in man and plant et cetera. Every part of the curriculum can be so positively influenced and affected by the use of computer. With the computer, a virtual laboratory can be produced where students perform practical exercises as if it were in real life situation. Consequently, this study was carried out to determine the effects of Computer-Based Animation Program and Charts on students' performance in the application of the concept of Cell division in Biology.

Objectives of the Study

Accordingly the specific objectives of the study were:

1. To assess students' application of the concept of Cell division when taught using Computer-based Animation Program with those taught using Chart.
2. To compare the performances of male and female students taught Cell division using Computer-based Animation Program with those taught using Chart, with respect to their application of the concept.

To determine the students' application of the concepts of Cell division when taught using Computer-based Animation Program with those taught using Chart given their attitude to Biology.

Research Questions

The following research questions were answered in the study.

1. To what extent do the performances of students taught the concept of Cell division using Computer-based Animation Program differs from those taught using Chart, with respect to their application of the concept?

2. What difference exists in the application of Cell-division by male and female students when taught using Computer-based Animation Program and Chart?
3. What difference exists in the application of the concept of Cell division by students taught using Computer-based Animation Program with those taught using Charts given their attitude to Biology?

Hypotheses

The following null hypotheses were tested in this study at a probability level of 0.05.

HO₁: There is no significant difference between the application of the concept of Cell division by the students taught with Computer-based Animation Program and those taught using Chart.

HO₂: There is no significant difference between the application of Cell division by male and female students when taught using Computer- based Animation Program and Chart.

HO₃: There is no significant difference between the application of the concept of Cell division by students taught with Computer-based Animation Program and those taught using Chart, given 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, Computer-Based Animation Program and Charts served as independent variables while students' gender and attitudes towards Biology (Cell division) served as moderating variables. Students' performance in the test administered served as measures of application (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 (BAQ) constructed and developed by the researcher were used to gather the relevant data for the study. The BPT consisted of 20-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 its 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: To what extent do the performances of students taught the concept of Cell division using Computer-based Animation Program differs from those taught using

Chart, with respect to their application of the concept?

HO₁: There is no significant difference between the application of the concept of Cell division by the students taught with Computer-Based Animation Program and those taught using Chart.

Table 1: Mean performances of students’ application of Cell division in experimental and control groups and ANCOVA summary

Group	N	Mean Mean		Mean Gain Scores
		Pretest Scores	Posttest Scores	
Experimental group (Computer-Based Animation Program)	80	11.90	32.37	20.47
Control group (Charts)	80	13.20	20.60	7.40

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5743.71	8	717.96	66.26	
Pretest	185.91	7	26.56	2.45	S
Methods	5117.15	1	5117.15	472.24	S
Error	1636.23	151	10.84		
Corrected Total	7379.94	159			
Total					

From Table 1 the posttest mean score for students in the experimental group, was 32.37 with a gain in mean score of 20.47, while the posttest mean scores for students in the control group was 20.60, with a gain in mean score of 7.40. This shows that the use of Computer-Based Animation Program facilitates students’ application of the concept of Cell division more than the use of Charts.

In addition, the calculated $F_{(1, 151)}$ value was 472.2, $p < 0.05$ level of probability. Thus the null hypothesis was hereby rejected. The result was that there is significant difference in the application of Cell division by students taught with

Computer-based Animation Program and those taught with Charts in favour of the experimental group.

Research Question 2: What difference exists in the application of Cell-division by male and female students when taught using Computer-based Animation Program and Chart?

HO₂: There is no significant difference between the application of Cell division by male and female students when taught using Computer-based Animation Program and Chart.

Table 2: Mean performances of students’ application of Cell division in experimental and control groups classified by gender and ANCOVA summary

Group	Experimental (Computer-Based Animation Program)				Control (Use of Chart)			
	N	Pre- test	Post test	Mean Gain	N	Pre- test	Post test	Mean Gain
Male	40	11.95	32.50	20.55	40	13.40	20.30	7.40
Female	40	11.80	32.30	20.50	40	13.10	20.40	7.30

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Model	5742.27	6	957.05	89.41	
Pretest	173.72	1	173.72	16.23	S
Methods	147.49	1	147.49	13.78	S
Gender	9.91	1	9.91	0.93	Ns
Interactions					
First order	0.01	1	0.01	0.00	Ns
Methods * Gender					
Error	1637.67	153	10.70		
Corrected Total	7379.94	159			

Table 2 showed that male students’ post test mean score for the experimental group was 32.50 while that of their female counterpart was 32.30. In the control group, the male students post test mean score was 20.80 while that of their female counterpart was 20.40. This shows that there is no difference in the application of Cell division by male and female students in experimental and control group. Though, both the male and

female students taught Cell division using Computer-Based Animations Program performed better than those taught using Chart with respect to their application of the concept.

In addition, the main effect of method was significant since its calculated $F_{(1, 153)} = 13.78$, $p < 0.05$ level of probability. Gender difference was not significant since its calculated $F_{(1, 153)} = 0.93$, $p > 0.05$ level of probability. Thus null hypothesis

accepted. The result is that there is no significant difference between the application of Cell division by male and female students when taught using Computer-based Animation Program and Chart. The interaction of Method and Gender was also not significant since its calculated $F_{(1, 153)} = 0.00$, $p > 0.05$ level of significance.

Research Question 3: What difference exists in the

application of the concept of Cell division by students taught using Computer-based Animation Program with those taught using Charts given their attitude to Biology?

HO₃: There is no significant difference between the application of the concept of Cell division by students taught with Computer-based Animation Program and those taught using Chart, given their attitude towards Biology.

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

Source of Variation	Sum of Squares	df	Mean square	F	Sig.
Corrected	10144.70	18	563.59	26.53	
Model					
Pretest	43.74	5	8.75	0.41	ns
Methods	3210.18	1	3210.18	151.09	s
Attitude	324.88	1	324.88	15.29	s
Interactions					
First order	47.70	1	47.70	2.25	ns
Methods* Attitude					
Error	2995.69	141	21.25		
Corrected Total	13140.40	159			

Teaching method/groups	Attitude	N	Pre-test	Post test	Mean Gain
Experimental	Positive	54	12.19	33.74	21.55
	Negative	26	11.23	29.54	18.31
Control	Positive	56	14.7	21.53	6.83
	Negative	24	9.66	18.37	8.71

Table 3 showed that, the post test mean for the experimental group with positive attitude was 33.74 with a gain in mean score of 21.55, while those with negative attitude have a posttest mean score of 29.54, with a gain in mean score of 18.31. In the control group (use of Chart), the posttest mean score for students with positive attitude was 21.53 with a gain in mean score of 6.83 while, those with negative attitude was 26.83, with a gain in mean of 15.13. This shows that in both control and experimental group, students with positive attitude performed better than those with negative attitude in terms of their application of the concept.

On further statistical analysis with ANCOVA, the main effect of Method was significant since its calculated $F(1, 141) = 151.09$, $p < 0.05$ level of probability. Attitude is significant since its calculated $F(1, 141) = 15.29$, $p < 0.05$ level of significance. This shows that there is significant difference in the effect of the attitude on students' application of the concepts of Cell division when taught with Computer-Based Animation Program and when taught with Chart.

Discussion of Findings

One of the major findings of this study is that the use of Computer-Based Animation Program in teaching Cell division facilitates students' application 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 Ndirangu (2006) [7], Yusuf and Afolabi (2010) [13] and Serin (2011) [12], 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. However, the finding is at variance with the findings of Mbaeze, Ukwando and Anudu (2010) [4] 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 was that there is no significant difference between the academic performance (application) 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 has the capacity to engage, motivate and enhance the performance of male and female students alike.

This finding is in consonance with the position of Onasanya, .3 and Asuquo (2006) [10], Ndirangu (2006) [7], and Yusuf and Afolabi (2010) [13] whose research findings [7] revealed that there is no significant difference between the performance of male and female students exposed to the use of Computer Assisted Instruction. Nevertheless, this research finding contradicts the conclusion of Mill (2001) [5]. According to him it is possible to infer that the significant difference observed may be accounted for by the novel nature of the CAI settings, in the Nigerian school setting and that male students performed better than their female counterpart when exposed to Computer Assisted Instructions.

In the case of students' 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 mean gain than those in the control group. Again, students with negative attitude in the experimental group had a higher mean gain than those in the control group. This shows that, the use of the Computer-Based Animation Program significantly improved the students' application of Cell division, even among those with negative attitude to Biology. This could be accounted for by the fact that the use of Computer-Based Animation Program of instruction appeals to them more than the use of other method.

This is in line with the findings of (Ndirangu, 2006; and Serin, 2011) [7, 12] whose research works showed that students' attitude influences their performance and use of Computer-Based Animation Program - Computer Assisted Instruction 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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