

EFFECTS OF COMPUTER ANIMATION INSTRUCTIONAL PACKAGE ON ACHIEVEMENT OF PRE-SERVICE BIOLOGY TEACHERS IN KWARA STATE COLLEGES OF EDUCATION, NIGERIA

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Abstract

This study investigated the Effects of Computer Animation Instructional Package (CAIP) on Achievement of pre-service Biology teachers in Kwara State Colleges of Education, Nigeria. Quasi-experimental design involving pretest, posttest experimental and control group design was adopted. A total of 368 pre-service Biology teachers formed the population of this study. The sample of the study 120 pre-service Biology teachers selected from intact classes of two co-educational Colleges of Education using multi-stage sampling technique. The experimental group of the study was selected purposively and this comprises 60 pre-service Biology teachers (32 male and 28 female) was taught through CAIP while their counterparts in the control group which comprises 60 pre-service Biology teachers (29 male and 31 female) was taught using conventional lecture method. The study answered two research questions and tested two null hypotheses. The instruments Cell Division Achievements Test (CDAT) used was developed, validated and administered to the students, the reliability coefficients of CDAT was established at $r = 0.95$. Research questions were analyzed descriptively using means and standard deviations. Null hypotheses were verified at $P \leq 0.05$ levels using ANCOVA. Results revealed significant difference in the academic achievement of pre-service Biology teachers exposed to the CAIP and those taught using conventional lecture method. The study also revealed no significant difference in the academic achievement of male and female students exposed to CAIP. From the findings of the study, it was concluded that using computer animation in cell division concepts has the potentials of enhancing pre-service Biology teachers' achievement. It was recommended, that the Federal and State Ministries for Tertiary Education to provide computers and projectors for teachers to facilitate teaching with animations.

Keywords: Computer Animation, Biology, Mitosis and Meiosis, Conventional Lecture Method, and Achievement

Introduction

Cell division is one of the important topics in Biology. Cell division as a concept in biology is considered abstract and difficult topic to learn (NCE Minimum Standard, 2016). Cell division is also a course in biology in which theories are the main products of scientific studies. According to Lisa, Michael, Steven, Peter and Jane (2016), cell division process is a part of the cell cycle. Cell division process includes two important processes such as mitosis and meiosis. Mitosis and meiosis is a continuous process and its complex concept most difficult to understand (Murniza, Halimal & Azlina, 2010). Students find it difficult to comprehend the chromosomal movement during cell division process because the events of cell division are not conspicuous. Wekesa, Wekesa and Amadalo (2013) submitted that mitosis and meiosis serve as the basis for understanding about the molecular events of cell division and are difficult to observe through

the naked eyes. However, understanding and construction of the knowledge about mitosis and meiosis concepts at molecular level depends on the ability of the students' visualization of the chromosomes movement during mitosis and meiosis. From an educational perspective, visualization helps students' understanding of complex processes, because it helps in the conversion of an abstract concept into a specific visual object that can be mentally manipulated.

Study of Ozcan, Yildirim and Ozgur (2012), Aziz and Ami Norliyana (2011) shows that students' poor understandings and poor mastery level for both mitosis and meiosis concepts cause difficulty in understanding of cell division concepts and make the students to have misconceptions about two important concepts of cell division. Misconceptions about Biology abstract concepts affect students' achievement. Thus, the problem of misconception should be considered in the learning process of an individual (Ozcan, et al., 2012). Students have misconceptions and lack of understanding about Cell Division topic due to the use of many instructional methods that require memorization of the concepts (She & Chen, 2009). Students' misconception is difficult to replace if teachers use conventional teaching methods alone (Aziz & Ami Norliyana, 2011).

Many students are said to have wrong conceptions about cell division concepts on the basis of how they were taught biology in schools. This opinion is in line with the submission of Awodun and Oyeniyi (2018) and Ezeaghasi (2018) in separate studies stated that the poor teaching methods adopted by teachers have been one of the major factors contributing to poor performance of students in Biology. Adebayo and Oladele, (2016) and Bello (2014) in separate studies opined that biological science has more conflicts in the classroom with conventional lecture method especially cell division and genetics concepts than any other biological concepts. Chattopadhyay (2012) and Ozcan, *et al.*, (2012) identified students' difficulties in understanding cell division concepts. The researchers both concluded that students fail because teachers are using ineffective teaching methods that cannot help overcome some misunderstanding and boost students' performance in cell division concepts. Aderogba (2012) explains that teaching still remains the old conservative approach of teachers acting as repertoire of knowledge and students the dormant recipients. The teacher-centred method emphasizes learning through the teachers' guide at all times which favours passive reception of knowledge by the students hence limiting students from learning from variety of sources. The performance of NCE I preservice Biology teachers in Bio 112 (2012-2017) is shown in Table 1

Table 1: Results of N.C.E I preservice Biology teachers in Bio 112 (Cell-Biology) 2012 – 2017 session

Year	No. of candidate that sat for the exam	Passed at credit level (A C) %	Passed (D-E) %	Failed (F) %
2012	850	201(23.65)	184(21.65)	465(54.47)
2013	544	111(20.40)	104(19.12)	329(60.48)
2014	343	98(28.57)	96(27.99)	149(43.44)
2015	322	75(23.29)	134(41.61)	113(35.09)
2016	216	32(14.81)	63(29.17)	121(56.02)
2017	168	21(12.5)	24(14.29)	123(73.21)

Source: Exam and Records, Kwara State College of Education (Technical), Lafagi

The use of Information and Communication Technology (ICT) tools such as computer has made the process of teaching and learning more enjoyable and interesting. Today, such tools provide both students and teachers with more opportunities in adapting learning and teaching to individual needs and the society at large (Mikre, 2011). To make Biology more relevant, enjoyable, easy and meaningful to learners, adequate instructional materials need to be provided and properly utilized as the teaching and learning situation may demand. This is where Information and Communication Technology (ICT) comes in. Interestingly, the use of ICT in the classroom has proven to be effective in the teaching and learning of sciences (Owolabi, Babatunde & Gambari, 2019; Bamidele & Yoade, 2017). Integrating computers into the classroom will help to broaden and deepen the students' knowledge as well as to expose students' difficulties in conceptualization, and engage students actively in the learning process (Falode, Sobowale, Saliu, Usman & Falode, 2016). This is because it offers new, creative and the most engaging ways of teaching. Falode, *et al.*, (2016); Bello, (2014); Duyilemi, *et al.* (2014) and Olodu, *et al.*, (2014) in separate studies submitted that the use of computer as instructional tool in science lesson has made the process of teaching and learning not only enjoyable, interesting and more meaningful to the learner but also enables the learner acquire a wide range of skills in Information and Communication Technology.

The advent of information and communication technology especially the product aspect has influenced both the content as well as methods of teaching. The use of ICT provides an enabling environment through which different types of learners (visual, audio, kinesthetic etc) learn. Most of the developed countries have exploited the potentials of Information and Communication Technology (ICT) to transform their educational landscape at the tertiary, secondary and even primary school levels particularly the instructional process (Ezeaghasi, 2018; Bello, 2014; Olubola & Aladejana, 2013). Computer Animation is ICT based teaching and learning methods that has proven to aids students understanding of difficult concepts (Yisa & Ojiaku, 2016). Computer Animation Instruction is more effective way of teaching and learning. Computer Animation is an electronic device or object of instruction in a physical world of matter through a machine with moving objects of many characteristics (graphic, pictures, shape etc.) indicating action, reactions, skills results, product in learning process (Yisa & Ojiaku, 2016).

Computer Animations are techniques, which aim to provide the learner with a highly simplified reproducible part of a real or imaginary world. Animations are considered one of the most effective ways to promote deep conceptual understanding of the real world (Falode *et al.*, 2016). Technology such as Computer Animation instructional packages makes teaching effective as learning is enhanced with images, video and sound.

Computer animation, which is basically a form of pictorial presentation, has become the most prominent feature of technology-based learning environments. It refers to simulated motion pictures showing movement of drawn objects. Recently, educational computer animation has greatly increased since the advent of powerful graphics-oriented computers. Computer animation instructional packages are tools that have the capacity to improve quality learning. It seeks to arouse students' interests, stimulates thinking and concretizes knowledge that could otherwise be explained in abstract terms (Bamidele & Yoade, 2017). This aspect of multimedia learning supports student-centered strategy whereby learners take responsibility in learning process. Computer animation is a subset of computer program which literally connotes the animation of concepts that are abstract in nature. Bamidele and Yoade (2017) reported that computer animations have the potentials of increasing the probability that students will learn more, retain better and even improve students' performance of the skills students are expected to develop. Computer animation instructional packages are learner-centered strategies and a learning environment in which when employed can promote

interaction, interest and attentiveness etc. Yisa and Ojaku (2016) studies shows that students who learn from computer animation have greater achievement and motivation. The studies also show that students retain information and the ability to sustain the learning process increases. These learner-centered instructional strategies can enhance a stimulating learning environment in which learners interest can increase positively and this can lead to increased attention, retention, concentration, knowledge and learning (O'Day, 2007).

Conventional lecture method is considered teacher-centered method which emphasizes learning through the teacher's guidance at all times. Students are expected to listen to lectures and learn. The teacher often talks at the students instead of encouraging students to interact, ask questions, or make students understand the lesson thoroughly (Umar, 2011). It does not promote insightful learning and long-term retention of some abstract concepts in biology (Ahmed & Abimbola, 2011; Umar, 2011).

Achievement is an important academic factor that has been identified to be influenced by teaching methods. Achievement is the process of getting something done successfully especially using effort and skill. Hence academic achievement refers to the accomplishment of academic goals, the educational outcomes of students or rather the extent to which a student, a teacher or an instructor has achieved the stated educational objectives. Falode, *et al.*, (2016) viewed achievement as measurable changes in students' behavior in academic as a result of exposure to a given concept. Different findings have emanated from researches carried out on effects of computer animation instructional packages on students' achievement. Ezeaghasi (2018) in a study discovered that the achievement of NCE II students taught evolution through computer animation instructional package was statistical different in favour of the former. Hence, the achievement of NCE I pre-service Biology teachers in cell division vis-a-vis students exposure to computer animation is worthy of investigation.

Statement of the Problem

The conventional lecture method is classroom-based and consists of lectures and direct instructions conducted by the teacher which emphasizes learning through the teacher's guidance at all times. The persistence use of this conventional lecture method makes learners passive rather than active learners (Ahmed & Abimbola, 2011). Studies in Biology indicated that many teachers prefer the lecture method of teaching and shy away from innovative methods of learning. Limited literature exists on the effects of computer animation instructional package on pre-service Biology teachers' achievement in Biology at Colleges of Education in the study area. It is in the light of this that the present study seeks to develop Computer Animation Instructional Package (CAIP) to teach cell division to Colleges of Education NCE I pre-service Biology teachers.

Research Questions

The following research questions were raised to guide the study:

- (i) What is the effect of computer animation instructional package on NCE I pre-service Biology teachers' achievement taught cell division and those pre-service Biology teachers' taught using conventional lecture method?
- (ii) What is the difference in the achievement of male and female NCE I pre-service Biology teachers taught cell division using computer animation instructional package?

Hypotheses

The following null hypotheses were tested at $p \leq 0.05$ levels of significance:

H₀₁: There is no significant difference in the achievement of NCE I pre-service Biology teachers taught cell division using computer animation instructional package and those pre-service Biology teachers taught using conventional lecture method.

HO₂: There is no significant difference in the achievement of male and female NCE I pre-service Biology teachers taught cell division using computer animation instructional package.

Methodology

The research design used for this study is a quasi-experimental design involving Pre-test, Post-test experimental and control groups design. The instrument for the study was Cell Division Achievement Test (CDAT) which was used to determine the achievement of the NCE I pre-service Biology teachers.

The pretest was administered using CDAT instrument to Experimental and control groups before treatment to establish equivalence in prior knowledge of the two groups respectively. The treatment for the study in experimental group was computer animation instructional package (CAIP) while the control group received conventional lecture method. This was followed by posttest after six weeks of teaching to determine the students' achievement in cell division concepts. The population of this study consists of all NCE I pre-service Biology teachers in Kwara State Colleges of Education Nigeria, who registered for 2018/2019 academic session. There are three State Colleges of Education in Kwara State. A total of three hundred and sixty-eight (368) NCE I pre-service Biology teachers formed the population of this study. One hundred and twenty (120) NCE I pre-service Biology teachers were sampled using intact classes. The sample was in line with the central limit theorem which stressed that adequate sample should cover between 10-15% of the total population Tuckman (1975). The sample was selected using multi-stage sampling technique. The experimental group of the study was selected purposively. That is, the college with the availability of serviceable quantity of computers was selected. College of Education (Technical), Lafiagi was used for experimental study because of the availability of 350 setters equipped computer laboratory. While the control group of the research was randomly selected. The experimental group taught cell division concepts with computer animation instructional package was made up of 60 NCE I pre-service Biology teachers (32 male and 28 female) while the control group taught with conventional lecture method was made up of 60 (29 male and 31 female). Computer Animation Instructional Package (CAIP) was validated by two Educational Technology specialists at Federal University of Technology, Minna and two Colleges of Education lecturers currently teaching Biology. Also, Cell Division Achievement Test (CDAT) was validated by two Biology specialists at Federal University of Technology, Minna. Based on experts' suggestions and recommendations, the instruments were modified and re-structured. The CDAT was made up of 30 multiple choice items constructed by the researcher. Each item was provided with four possible options out of which a student is expected to choose the correct answer. One mark (1mark) was awarded for every correctly answered question while no mark was awarded to each question answered wrongly. The score obtained out of 30 was later converted to percentage.

Trial testing and pilot study of CAIP and CDAT were carried out in a College of Education within the study area but outside the Colleges selected for the main study using 25 NCE I pre-service Biology teachers and ICT facilities in the College computer laboratory. After a single administration of the test instrument, the test and retest method was used and the reliability co-efficient of 0.95 was obtained using Pearson Product Moment Correlation coefficient. After the research instruments were validated and found reliable, they were administered on NCE I pre-service Biology teachers selected for the main study in the respective Colleges using facilities in computer laboratory for NCE I pre-service Biology teachers in experimental group

and lecture room for NCE I pre-service Biology teachers in the control group. The data gathered were analyzed with descriptive and inferential statistics. The hypotheses were analyzed using ANCOVA statistics to ascertain the significant difference between the groups using Statistical Package for Social Sciences (SPSS version 20) at 0.05 alpha level of significance.

Research Question 1: What is the effect of computer animation instructional package on NCE I pre-service Biology teachers' achievement taught cell division and those NCE I pre-service Biology teachers' taught using conventional lecture method?

Table 1: Mean (\bar{X}) and Standard Deviation comparison of pretest and posttest score of NCE I PreService Biology Teachers in Experimental and Control Groups

Groups	N	Pretest		Posttest		Mean (\bar{X}) Gain	Mean (\bar{X}) Difference
		Mean (\bar{X})	SD	Mean	t		
EXPERIMENTAL	60	11.05	3.29	25.95	3.06	14.90	9.64
CONTROL	60	9.82	2.77	15.08	2.30	5.26	

Table 1 shows the Mean (\bar{X}), Standard Deviation and Mean Gain between of NCE I pre-service Biology teachers in both experimental and control groups. The experimental group had a Mean (\bar{X}) value for pretest and posttest as 11.05 and 25.95 respectively with Standard Deviation (SD) of ± 3.29 and ± 3.06 respectively, while the mean gain from pretest to posttest is 14.90. The control group pretest and posttest are 9.82 and 15.08 with Standard Deviation (SD) of ± 2.77 and ± 2.30 respectively and the mean gain is 5.26 indicating that the experimental group performed better than the control group. The mean (\bar{X}) difference between the two groups is 9.64 in favour of experimental group.

Research Question 2: What is the difference in the achievement of male and female NCE I pre-service Biology teachers taught cell division using computer animation instructional package?

Table 2: Mean (\bar{X}) and Standard Deviation (SD) of Male and Female NCE I Pre-Service Biology Teachers within Experimental Group only

Groups	N	Pretest		Posttest		Mean (\bar{X}) Gain	Mean (\bar{X}) Difference
		Mean (\bar{X})	SD	Mean	t		
MALE	32	10.19	3.40	25.84	3.07	15.65	1.62
FEMALE	28	12.04	2.91	26.07	3.10	14.03	

The Table 2 shows the Mean (\bar{X}) score and Standard Deviation of male and female NCE I preservice Biology teachers taught using computer animation instructional package. The male had a Mean (\bar{X}) value for pretest and posttest as 10.19 and 25.84 respectively and Standard Deviation (SD) of ± 3.40 and ± 3.07 respectively, while the female preservice Biology teachers in the same group had a Mean (\bar{X}) score of 12.04 and 26.07 with Standard Deviation (SD) of ± 2.91 and ± 3.10 respectively. This indicated that there is a mean difference of 1.62 between the pretest and posttest mean achievement scores of male and females preservice Biology teachers taught cell division concepts using computer animation instructional package in favour of male.

HO₁: There is no significant difference in the achievement of NCE I pre-service Biology teachers taught cell division using Computer Animation Instructional Package and those taught without Computer Animation Instructional Package

Table 3: ANCOVA Analysis of NCE I Pre-Service Biology Teachers in Experimental and Control

Source	Type III Sum of Squares	df	Mean (X) Square	F _{cal}	P _{val.}	Remarks
Corrected Model	3632.487 ^a	2	1816.244	274.025	.000	
Intercept	2515.703	1	2515.703	379.555	.000	
Pretest	89.954	1	89.954	13.572	.000	
Treatment	3232.207	1	3232.207	487.657*	.000*	Significant
Error	775.479	117	6.628			
Total	54920.000	120				
Corrected Total	4407.967	119				

*: Significant at $p < 0.05$

Table 3 shows the Analysis of Covariance (ANCOVA) of NCE I pre-service Biology teachers taught cell division concepts using Computer Animation Instructional Package and Conventional lecture method. The ANCOVA result ($F_{cal} = 487.657 (1, 117), p < 0.05$). The treatment computer animation instructional package and conventional teaching method produced a significance difference on NCE I pre-service Biology teachers' achievement. This is an indication that there was a significance difference between experimental and control groups hence, the research hypothesis one was therefore rejected.

HO₂: There is no significant difference in the achievement of male and female NCE I pre-service Biology teachers*taught cell division using Computer Animation Instructional Package

Table 4: ANCOVA Analysis of Male and Female NCE I Pre-Service Biology Teachers within Experimental Group

Source	Type III Sum of Squares	Df	Mean (X) Square	F _{cal}	P value	Remarks
Corrected Model	168.357 ^a	2	84.179	12.479	.000	
Intercept	1768.210	1	1768.210	262.132	.000	
Pretest	167.583	1	167.583	24.844	.000	
Gender	7.919	1	7.919	1.174	.283 ^{ns}	Not significant
Error	384.493	57	6.745			
Total	40957.000	60				
Corrected Total	552.850	59				

ns = not Significant at $p > 0.05$

Table 4 shows the Analysis of Covariance (ANCOVA) of male and female NCE I pre-service Biology teachers taught cell division concept using computer animation instructional package. The ANCOVA result ($F_{cal} = 1.174(57)$ $p > 0.05$). The treatment using computer animation instructional package produced a no significant difference on male and female students' achievement. This indicates that, there is no significance difference between the academic achievement of male and female NCE I pre-service Biology teachers in the experimental group. Hence, the research hypothesis two is retained.

Summary of Findings

The Computer Animation Instructional Package enhanced NCE I pre-service Biology teachers' academic achievement better than those using conventional lecture method. The use of Computer Animation Instructional Package to teach cell division concept has the same effect on academic achievement of both male and female NCE I pre-service Biology teachers. Thus, indicating that the method is not gender bias.

Discussion of Findings

The research question one was answered by testing the corresponding hypotheses. Hypotheses one which states that there is no significant difference in the achievement of NCE I pre-service Biology teachers taught cell division using Computer Animation Instructional Package and those taught without Computer Animation Instructional Package. The result revealed that using computer animation instructional package enhanced NCE I pre-service Biology teachers' achievement in cell division than using conventional lecture method (Table 3). The significant difference in favour of the experimental group computer animation instructional package suggests a greater effectiveness of the teaching method which was used to teach the experimental group over the conventional lecture method which was used for the control group. This might be due to change in mode of instructions that is from teacher-centered (i.e. conventional lecture method) to students-centered (i.e. activity oriented). Secondly, the NCE I pre-service Biology teachers were able to interact with one another within the group and the computer animation instructional package helped them to understand cell division concepts better because they were able to interact and visualize the concepts involved. Hence, the null hypothesis which state there is no significant difference in the achievement of NCE I pre-service Biology teachers taught cell division using Computer Animation Instructional Package and those taught without Computer Animation Instructional Package is rejected. The finding agrees with Ezeaghasi (2018), Bamidele and Yoade (2017), Ikwuka and Samuel (2017), Falode, *et al.*, (2016), Olorukooba, *et al.*, (2016), Yisa and Ojiaku (2016), Elangovan and Ismail (2014) and Bello (2014)'s finding which reveals that students exposed to Computer Animation Instructional Package performed significantly better than those exposed to the conventional lecture method. This finding gain further support from the work of Thomas and Israel (2014) on effectiveness of animation and multimedia teaching on students' performance in science subjects. The finding revealed that there is significant difference in the academic achievement of students exposed to animated media teaching over the lecture method. Kajuru and Ado (2012) established that, innovative teaching strategies with integrated resource materials enhance academic achievement of students.

The research question two was answered by testing the corresponding hypothesis. The result of testing null hypotheses two showed no significant difference as shown in Table 4. The result revealed that there is no significant difference in the academic achievement of male and female NCE I pre-service Biology teachers exposed to computer animation instructional package in cell division concepts. The implication of this result is that the use of computer animation instructional package is good for both male and female NCE I pre-service Biology teachers. The null hypothesis which state that, there is no significant difference in the achievement of male and female NCE I pre-service Biology teachers taught cell division using

Computer Animation Instructional Package is retained. This finding is in harmony with Okwuduba, et al., (2018), Ezeaghasi (2018), Adebayo and Oladele (2016), Olorukooba, et al., (2016), Falode, et al., (2016), Nireti, et al., (2014) and Oludipe (2012) who in their separate studies in various discipline found that the application of computer animation instructional package treatment on a mixed gender school population improves the academic achievement of students irrespective of gender. The findings of Okwuduba, et al., (2018) revealed that there is no significant difference in the performance of gender in chemistry due to exposure to Computer Animation Instructional Package. Ezeaghasi (2018) found no significant difference in the academic achievement between male and female pre-service NCE II Biology teachers taught Ecology using computer animation instructional package. Falode, et al., (2016), further supports this assertion in their study on effectiveness of computer animation instructional package on academic achievement of senior secondary school agricultural science students in animal physiology in Minna, Nigeria, the package improved the achievement of both male and female students taught. In addition, Nireti, et al., (2014), opines that Computer Animation Instructional Package enhances academic achievement of students in spite of their gender. The findings from this study therefore indicated that teaching with computer animation instructional package can enhance academic achievement of cell division concepts among NCE I pre-service Biology teachers.

Conclusion

Based on the finding of the study, the researcher concluded that: computer animation instructional package in cell division concept has the potentials of enhancing NCE I pre-service Biology teachers' achievement.

Recommendation

Teacher-trainers like the Colleges of Education and Universities should incorporate computer animation instructional package into their methodology curricular at all levels. This will ensure the development of its knowledge in the teachers on training.

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