
Impact of Simulation Models on Students' Achievement and Retention of Cell Division Concept in
Colleges of Education in North West, Nigeria

By

Ezeaghasi, Ngozi Eucharia and Obochi, Maria Uchechukwu

Department of Biology
Federal College of Education, Zaria.

Department of Biology
Federal College of Education, Zaria.

ABSTRACT

This study investigated the NCE 1 students' achievement and retention of cell division concept in biology when taught using computer simulation models. The research employed Pretest, Posttest and Retention test using one experimental group and one control group. A pretest was administered before the treatment to establish the equivalence of the experimental and control groups. The subjects in the experimental group were taught using Computer simulation model while those in control group were taught using lecture method. Cell Division Concept Performance Test (CDCPT) was used to obtain data from 176 NCE I biology students of Federal Colleges of Education in North west Nigeria consisting of 72 male and 104 female ; that made up the sample size using simple random sampling techniques. The instrument was validated by three PhD holders from the Department of Science Education, Ahmadu Bello University Zaria, where the reliability coefficient of 0.75 was obtained. Three research questions and three null hypotheses were tested at 0.05 level of significance. The major findings from the study revealed significant difference between the mean academic performance score of NCE I Biology students taught cell division concepts using computer simulation models and those taught the same concept using lecture method in favour of the experimental group. There is also significant difference in the retention ability of NCE I Biology students exposed to cell Division concepts using computer simulation models and those exposed to the same concept using lecture method in favour of computer simulation model. Based on the findings it was concluded that Students learn Cell Division concepts in biology better when taught using computer simulation model of instruction at NCE I level. The computer simulation model of instruction affects the academic performance and retention ability of students positively when taught Cell Division concepts in biology better than lecture method. It was therefore recommended that Biology teachers should adopt the use of computer simulation model in teaching topics like Cell Division at NCE 1 level since the findings revealed its effectiveness in enhancing academic performance and retention of concept learnt.

Key words: Computer Simulation, biology, cell division, lecture method.

INTRODUCTION

The impact of science and technology on education cannot be over-emphasized. The advent of information and technology especially the product aspect has influenced

both the content as well as methods of teaching. Most of the developed countries have exploited the potentials of Information Communication Technology (ICT) to transform their educational landscape at the

tertiary, secondary and even primary school levels particularly the instructional process Wekesa, (2003). Generally, ICT holds out the opportunity to revolutionize pedagogical methods, expand access to quality education, and improve the management of education systems (World Bank, 2002). Nigeria, especially in the educational sector has not properly harnessed the potentials of Information Technology (IT) in terms of the educational uses as in developed countries like America and Britain. Unfortunately, in Nigerian classrooms, the typical pedagogical pattern, which reflects an authoritarian didactic approach to classroom management, does not prepare students for the information age and globalization. In other words, this pattern is not equipping students to live effectively in our modern age of science and technology (Olubola & Aladejana 2013) and (Duyilemi, Olagunju & Olumide, 2014). Computer simulation is ICT based teaching and learning methods (Clark, Nelson, Sengupta & Angelo, 2009).

Biology is a branch of science that deals with the study of living organisms. Biology is primarily concerned with the nature of organisms and their relationship to each other and to their environment. Biology as a subject enable one understand major biological processes (Physiological) example digestion, respiration, circulation, excretion and gaseous exchange. Through Biology organisms tend appreciate the effect of these biological processes and the larger environment as a whole. Biology like other science subjects is a practical oriented discipline which seeks to develop in a learner, scientific inquiry and problem solving skills. The general goals of Biology Education is to equip the learner with the basic knowledge, skills and attitude that will enable one to lead

an independent and useful life .The Biology subject caters for the needs of a learner who may pursue studies in the subject and its related disciplines. In many areas, biological knowledge can be applied in general improvement of man's well-being as evidenced in Medicine, Agriculture and Industry (Samikwo, 2013).

Many concepts or topics in biology according to Cimer (2011) are perceived to be difficult to learn by students , these includes water transport in plants, protein synthesis, respiration and photosynthesis, gaseous exchange, evolution, cells division , mitosis and meiosis, physiological processes, hormonal regulation, oxygen transport, genetics, Mendelian genetics, genetic engineering, and the central nervous system. Experiencing difficulties in so many topics in biology negatively affects students' motivation and achievement (Araoye (2013). Students' difficulties with many topics in biology have stimulated researchers to investigate why students experience such difficulties and how to overcome these difficulties. There are many reasons why students have difficulties in learning biological concepts according to (Araoye 2013). The nature of science itself and its teaching methods are among the reasons for the difficulties in learning science,

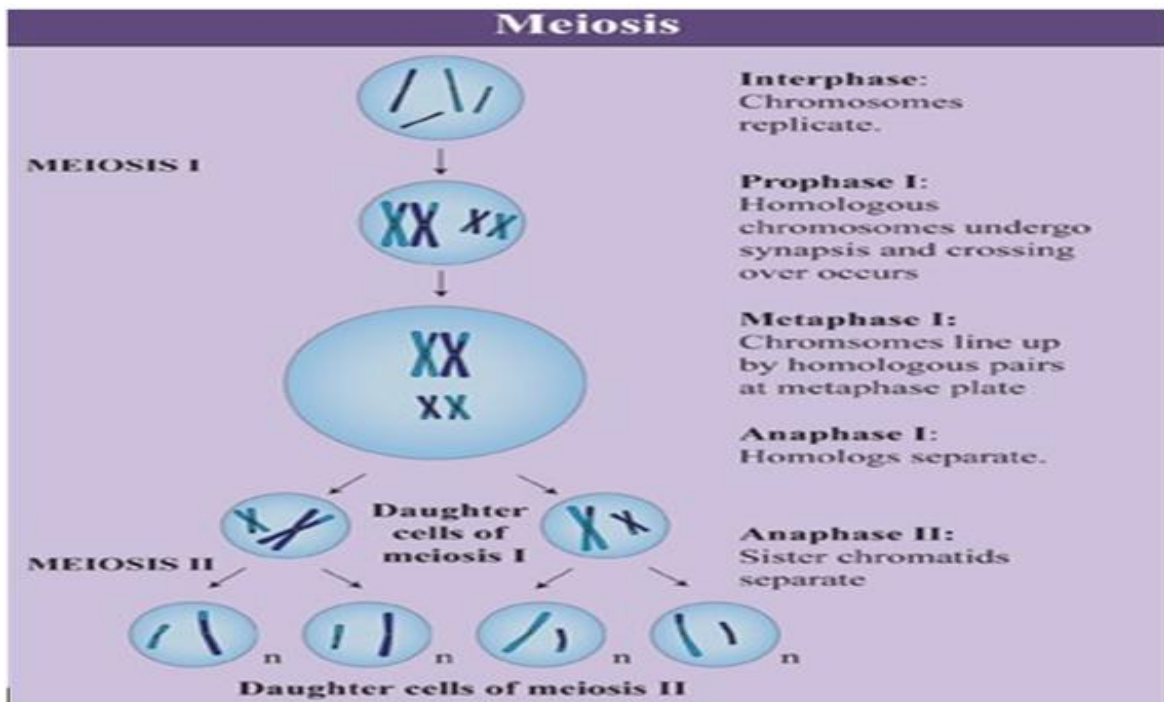
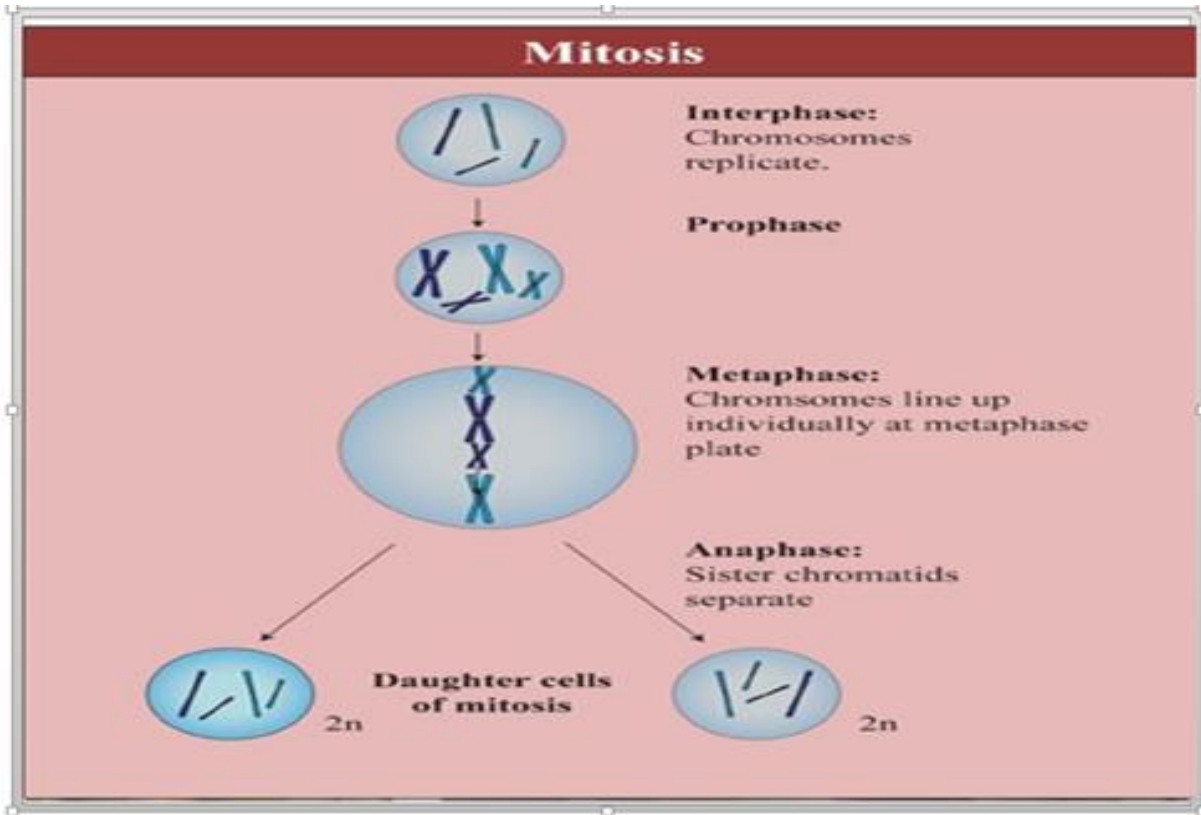
Current trend in science teaching is to integrate technology into the classroom in a variety of ways (Kiboss, Ndirangu & Wekesa, 2004; Yusuf & Afolabi, 2010). These include, the ability to shift learning to more hands-on and visual imagery interaction that is often lacking in traditional teacher-based classroom, It natures confidence, initiative and enhances cognition, psychomotor and effective behaviour. It provides immediate feedback and it is self- paced (Wekesa,

Wekesa & Amadalo 2013). The fast changes in science and technology in recent times have affected education systems. Seyhan (2015) students of today need to be able to adapt to a rapidly changing technological world. As a result of these fast changes, the education systems need to be modified to education systems that can activate the students to learn ways to reach knowledge, to develop solutions for problems yet unknown and to enhance the skills of decision-making (Ince Aka, Güven & Aydoğdu, 2010). Science education reformers have supported the idea that learners should be engaged in the excitement of science, they should be helped to discover the value of evidence-based reasoning and higher-order cognitive skills and be taught to become innovative problem solvers (Perkins & Wieman, 2008). So, it is important for students to be prepared for the future by facing real problems in their learning environment and producing appropriate solutions to these problems (Chin & Chia, 2004). Students should be given opportunity to discover, invent and get caught up in the rapid expansion in science and technology. Biology has made great impact in the development of nations and its importance warrants the need to expose biology students to innovative methods like computer assisted instructions.

Computer simulation is one of the modes of CAI which gives students the opportunity to observe a real life experience, and has been applied in the teaching and learning of various courses and subjects with promising results. Ezeaghasi, (2017); Olele, (2008) and Duyilemi, Olagunju & Olumide, (2014) reported that most of the research findings showed a positive impact on computer simulation based teaching and learning method. This is because of its

features that consist of movement and color which bring real learning environment into biology classroom. The use of computer as a complement to conventional instruction produced higher performance than the use of conventional instruction alone (Gambari, Yaki and Olowe, 2013; Ezendu & Okeke 2013 and Yusuf & Afolabi, 2010). In the light of the recent trends in technological advancement and in science education, the researcher examined understanding the concept of cell division in biology using computer simulation models on academic performance among NCE I Biology Students. According to Olubola & Aladejana (2013), in the years past, classrooms were a cycle of memorisation, repetition, and note copying and these agreed perfectly the world around the period, but now, the world is increasingly shaped by ICT. Technology has become an integral part of our everyday lives; at home learners come in contact with mobile phones, television, computers, internet, games, cash registers, bar-code scanners, traffic lights, automatic doors, security cameras, remote controls, fax machines, the list can go on and on. The conflict then arises when such students get to the classroom and are still expected to listen, write and regurgitate. Thus, the 21st Century classroom must be matched with the 21st Century education which should be flexible, creative, challenging, and complex. Computer programmes can present instruction at the learner's pace and keep track of the learner's errors and progress. Computers capture the learners' attention because the programmes are interactive and engage the learners' spirit of competitiveness to increase their scores by developing students' problem-solving abilities by allowing them to analyze and decompose a

problem by using systematic trial and error to find solutions (Araoye (2013).



Cell division is a continuous process but a series of stages are assigned marking the significant features at a given time. The stages involved are: (i) interphase, (ii) prophase, (iii) metaphase, (iv) Anaphase, and (v) Telophase.

The dynamics and chromosomal orientation during the process of cell division are pertinent to the understanding of the concept by the students of biology. Yet the process does not come out vividly in conventional instructional methods and in biology textbooks. Traditionally, cell division has been taught via traditional lecture and laboratory methods that involve use of squashed young onion root tip. However, a current trend in science is to integrate technology into the classroom in a variety of ways (Wekesa, 2003; Kiboss et al., 2004). One such area is Computer-Based Simulation (CMS), which has been applied in the teaching and learning of various courses and subjects with promising results (Mkpanang, 2010)

A computer simulation improves the teachers' repertoire by enhancing and expanding the educational environment particularly in areas considered difficult or dangerous (Wekesa, 2003). Several benefits attributed to CMS have been reported. These include: the ability to shift learning to more hands-on and visual imagery interaction that is often lacking in traditional teacher-based classroom. It natures confidence, initiative and enhances cognition, psychomotor and effective behaviour. It provides immediate feedback and it is self-paced. The ability to employ animated colour graphic enhanced features of the computer to demonstrate concepts is the most valuable component of CMS because it may enhance students' conception.

The conventional teaching 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 teacher often talks at the students instead of encouraging them to interact, ask questions, or make them understand the lesson thoroughly. The persistent use of the conventional method makes students passive rather than active learners (Ahmed & Abimbola, 2011). Poor performance of students in the biology subjects has been a subject of concern to many stakeholders in education (Odili, 2006 and Okereke 2006, Olatoye, 2008). Studies in biology indicated that many teachers prefer the lecture method of teaching and shy away from innovative methods of learning. It was in the light of this, that this paper investigated the understanding the concept of cell division in biology using computer simulation on academic performance and retention among NCE I biology students in North West, Nigeria

Objectives of the Study

This study aimed at ascertaining the understanding of cell division concept in biology using computer simulation on students' academic performance and retention among NCE I Biology students in North-West, Nigeria. The objectives of this study therefore are to:

1. examine the effects of Computer simulation on students' academic performance in cell division concept of biology,
2. determine the effect of Computer simulation on retention ability of students in cell division concept of biology,

3. Examine the effect of Computer simulation on the academic performance of male and female NCE I biology students in cell division concept of biology.

Research Questions

The study seeks to answer the following research questions: -

1. What is the difference in the mean academic performance scores of NCE I Biology students taught cell division using computer simulation and those taught using lecture method?
2. What is the mean difference in retention ability of NCE I Biology students' taught cell division concept using computer simulation and those taught using lecture method?
3. What is the difference in male and female mean academic performance scores of students taught cell division concepts using computer simulation and those taught with lecture method?

Null Hypotheses

The following null hypotheses were tested in the course of this study at $p \leq 0.05$ levels of significance.

- Ho₁: There is no significant difference between the mean academic performance scores of NCE I Biology students taught cell division concept using computer simulation and those taught the same concept using lecture method.
- HO₂: There is no significant difference in the mean retention ability scores of NCE I Biology students exposed to cell division concepts using computer

simulation and those exposed to the same concept using lecture method.

- Ho₃: There is no significant difference between the mean academic performance scores of male and female NCE I Biology students taught cell division concepts using computer simulation model only.

RESEARCH METHODOLOGY

A Computer Simulation model was developed for this study. The model consists of three sub-units in cell division in animal: cell division; types of cell division and stages in cell division.

The computer simulation used was macromedia flash and fireworks program language. It contained the content of cell division which was installed on stand-alone computer in computer laboratories of the sample schools. During the lesson, computer displays simulation of cell division to the learners on each of the sub-units. Students jot down notes on the processes and activities that happen at each stage of cell division. After each stage of the presentation, students were assessed using multiple choice objective questions to measure their comprehension.

Quasi-experimental design involving Pretest and Posttest and Postposttest using experimental and control group. The instruments for the study includes cell division concept Performance Test (CDCPT) which was developed by the researcher. The Pretest was administered using CDCPT instruments to Experimental group and control group before treatment to establish equivalence in prior knowledge of the two groups. The treatment for the study in experimental group was computer simulation model while the control group received lecture method. This was followed

by Posttest after three weeks of teaching to determine the students' academic performance in students taught Cell Division concepts. The population of this study consists of all NCE I biology students in Federal Colleges of Education of North West Zone of Nigeria, who registered for 2016/2017 session. . The total number of four hundred and nineteen (419) NCE I Biology students formed the population of this study. One hundred and seventy - six (176) students were sampled using random sampling techniques. 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 Cell Division Concept Performance Test (ECPT) consist of 40 multiple-choice questions The CDCPT were validated by three PhD holders with rank of Senior lecturers in the department of Science Education, Ahmadu Bello University, Zaria and a reliability coefficient of 0.75 for the instrument were obtained signifying a high positive correlation indicating that the instrument is reliable to test the study subject. Descriptive statistics of mean and standard deviation was used to answer the three research questions while an independent samples t-test was used to test the null hypotheses at $p \leq 0.05$ level of significance

Table 3.1: Population of NCE I Biology Students in the Study

S/N	College	Male	Female	Total
1.	FCE Zaria	40	56	96
2.	FCE Kano	34	52	86
3.	FCE Bichi	25	47	72
4	F C E Gusau	32	53	85
5	F C E Katsina	32	48	80
TOTAL:		163	256	419

SOURCE: National Commission for Colleges of Education (NCCE, 2016)

Table 3.2: Sample of the Study

S/N	Status	College	Male	Female	Total
1.	Experimental group	FCE Zaria	40	56	96
2.	Control group	FCE Katsina	32	48	80
			72	104	176

RESULT AND DISCUSSION

Research Question One: What is the difference between the mean performance scores of students taught Cell Division using computer simulation model and those taught using lecture method?

The pretest and posttest scores of NCE I students taught Cell Division using computer simulation model and those taught using lecture method was analyzed descriptively using mean and the mean difference as presented in Table 4.1.

Table 4.1: Mean Performance of Students taught using Computer Simulation Model and those taught using Lecture Method

Variables	N	Pretest	Posttest	Std. Deviation	Mean Gain/	Mean Difference
		Mean	Mean		Loss	
Experimental Group	96	16.07	22.30	4.88	6.23	8.25
Control Group	80	9.21	14.05	3.26	4.84	

Table 4.1 shows that there is a difference in mean between students taught Cell Division using computer simulation model and those taught using the lecture method with a mean difference of 8.25 in favour of those taught using computer simulation model. Similarly, in comparing the pretest and posttest scores for both the experimental and control group, both groups gained in performance after the treatment with mean gains of 6.23 and 4.84 for experimental and control groups respectively. This implies that teaching using computer simulation model has more positive impact on students' academic performance. However, to find out how significant the

difference in the mean scores is between the two groups, the data were subjected to an independent samples t-test.

Research Question Two: What is the difference between the mean retention ability scores of students taught Cell Division using computer simulation model and those taught same concepts using lecture method?

To answer this research question, the post-posttest performance mean scores of students taught biology concepts using computer simulation model and those taught using lecture method was used. The result is shown in Table 4.2.

Table 4.2: Mean and Standard Deviation of the Post-Posttest Scores of Students taught Cell Division using Computer Simulation Model and those taught using Lecture Method

Groups	N	Mean	Std. Deviation	Mean Difference
Experimental Group	96	29.36	4.78	13.08
Control Group	80	16.28	6.45	

Results from Table 4.2 shows the retention mean scores of 29.36 and 16.28 for students taught Cell Division using computer simulation model and those taught using lecture method respectively. The table revealed that students taught using Computer simulation retained the concepts more than those taught using the lecture

method with a mean difference of 13.08 in favour of subjects taught using computer simulation model. From the result, it can be deduced that subjects taught using computer simulation model retained the concepts more than those taught using lecture method. An independent samples t-test

Research Question Three: What is the difference in the academic performance of male and female students taught Cell Division using computer simulation model?

The mean and standard deviation of posttest academic performance of male and female students taught biology concepts using computer simulation model is shown in Table 4.3.

Table 4.3: Results of Mean, Standard Deviation and Mean Differences for Male and Female Students' Exposed to using Computer Simulation Model

Groups	N	Mean	Std. Deviation	Mean Difference
Male	44	16.55	5.06	0.88
Female	52	15.67	4.75	

Table 4.3 showed that there is a difference in mean performance between male and female students taught Cell Division using computer simulation model ($\bar{X} = 16.55$ and $\bar{X} = 15.67$ respectively) with a mean difference of 0.88 in favour of the male students. From the table it can be deduced that male students taught Cell Division using computer simulation model performed slightly better than their female counterparts. Conversely, to find out how significant the difference in the mean scores between male and female students taught Cell Division

using Computer simulation, their scores were subjected to an independent samples t-test.

Testing of Null Hypotheses

HO₁: There is no significant difference between the mean performance scores of students taught Cell Division using Computer simulation and those taught using lecture method.

An independent samples t-test was conducted to test the null hypothesis at $p \leq 0.05$ level of significance. The result of the analysis is presented in Table 4.4.

Table 4.4: Summary of t-test for Performance Scores of Students taught Cell Division using Computer simulation and Lecture teaching Method

Group	N	Mean	Std. Dev.	df	t-cal	t-crit	p-value	Remark
Experimental Group	96	22.30	4.84	174	11.24	1.98	0.00	Sig.
Control Group	80	14.05	4.87					

Significant at $P \leq 0.05$

Table 4.4 revealed that the p-value (0.00) is less than the 0.05 level of significance. The null hypothesis which states that there is no significant difference between the mean performance scores of students taught Cell Division using Computer

simulation and those taught using lecture method is therefore rejected. This implies that a significant difference exist in the academic performance of students taught Cell Division using Computer simulation and those taught using lecture method indicating

that students performed better when taught using Computer simulation model.

Null Hypothesis Two: There is no significant difference between the mean retention ability scores of students taught Cell Division

Computer simulation and those taught same concepts using lecture method.

An independent samples t-test was conducted to test the null hypothesis at $p \leq 0.05$ level of significance. The result of the analysis is presented in Table 4.5.

Table 4.5: t-test of Students' Retention ability when exposed to Computer simulation model and Lecture Method

Group	N	Mean	Std. Dev.	Df	t-cal	t-crit	p-value	Remark
Experimental Group	96	29.36	4.78	174	15.43	1.98	0.00	Sig.
Control Group	80	16.28	6.45					

Significant at $P \leq 0.05$

Table 4.5 revealed that the p-value (0.00) is less than the 0.05 level of significance. The null hypothesis which states that there is no significant difference between the mean retention ability scores of students taught biology concepts using simulation games teaching strategy and those taught same concepts using lecture method is therefore rejected. This implies that a significant difference exist in the retention ability of students taught Cell Division using Computer simulation model and those taught using lecture method indicating that

students retained more when taught biology concepts using Computer simulation model.

Null Hypothesis Three: There is no significant difference in the academic performance of male and female students taught Cell Division using Computer simulation model.

An independent samples t-test was conducted to test the null hypothesis at $p \leq 0.05$ level of significance. The result of the analysis is presented in Table 4.6.

Table 4.6: Summary of t-test for Performance Scores of Students taught Cell Division using Computer simulation model.

Group	N	Mean	Std. Dev.	Df	t-cal	t-crit	p-value	Remark
Male	44	16.55	5.06	94	0.87	1.99	0.37	Not Sig.
Female	52	15.67	4.75					

Not Significant at $P > 0.05$

Table 4.6 revealed that the p-value (0.37) is greater than the 0.05 level of significance. The null hypothesis which states that there is no significant difference in the academic performance of male and female

students taught Cell Division using Computer simulation model, is therefore retained. This implies is an indication that teaching Cell Division using Computer simulation model is gender friendly as there is no difference

between the performance of male and female students.

SUMMARY OF FINDINGS

1. Teaching Cell Division using computer simulation model and lecture method significantly affects the performance of secondary schools students ($p = 0.00$).
2. Students taught biology concepts using computer simulation model performed better than those exposed to lecture method ($p = 0.00$).
3. There was no statistically significant difference between male and female students taught Cell Division using computer simulation model ($p = 0.37$).

DISCUSSION

The findings indicated that the treatment was statistically significant on the students' performance. The introduction of computer simulation model of instruction has showed from the findings to improve students' academic performance in biology concept. This finding support previous assertion by Araoye (2013) that students taught through computer assisted instruction as supplementary strategy performed significantly better in science. This implies that the use of computer simulation must have facilitated and improve instruction thus improving understanding of the content of the subject and therefore improve students' academic performance. This result is in line with the study of Ezeaghasi, (2017) who ascertained that EVACS and EVOLVE computer simulation model have the potentials of enhancing the academic performance of biology students. Ezeudu and Okeke (2013) investigated the effects of simulation on students' achievement in

senior secondary school chemistry and reported that the use of the computer simulation package was more effective than the biology instructional model and conventional method of teaching respectively. The result is also in consistent with Mkpanang, (2010) who submitted that the integration of computer in secondary school curriculum produced positive effect on students' learning. The results was in agreement with the findings of Duyilemi, Olagunju and Olumide (2014) who reported that use of computer simulation model in teaching improved academic performance in the students, as well as encourage active participation of the learners. Gambari, Yaki and Olowe (2013) also revealed that there was significant difference in the mean performance scores of students in experimental groups (I and II) and control group and concluded that the use of the computer simulation package was more effective than the biology instructional model and conventional method of teaching.

CONCLUSION

Based on the finding of the study, the following conclusions were drawn

1. Students learn Cell Division concepts in biology better when taught using computer simulation model of instruction at NCE I level.
2. The computer simulation model of instruction affects the academic performance and retention ability of students positively when taught Cell Division concepts in biology better than lecture method. This may be as a result of student involvements and participation during the lessons.

RECOMMENDATIONS

Based on the findings of the study, the researchers recommends that:

Biology teachers should adopt the use of computer simulation model in teaching topics like Cell Division at NCE 1 level since the findings revealed its effectiveness in enhancing academic performance and retention of concept learned.

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