Effect Of Computer Simulation On Students' Achievement And Retention In Sexual Reproduction In Plants In Niger State, Nigeria

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ABSTRACT
This study investigated effect of computer simulation on students' achievement and retention in sexual reproduction in plants in Niger State, Nigeria. The study adopted a pretest, post-test Quasi Experimental, control group design, the population of the study consisted of 11,275 Biology students, 5903 males and 5372 females in all the 240 public co-education senior secondary school class two (SSII) in Niger State, in 2019/2020 academic session. Two research questions guided the study and two null hypotheses were formulated and tested at 0.05 level of significant. The sample size of the study was 178 SS II Biology students (84 girls and 94 boys) drawn from four coeducational senior secondary schools in zone B educational zone of the state. Multi-stage random sampling techniques was employed to select four intact classes in four different schools. Plant Reproduction Achievement Test (PRAT) was the instrument employed for data collection. Split half reliability method was used to analyse the data obtained from the trial testing of PRAT. A reliability index of 0.88 was obtained. ANCOVA was used to test the hypotheses while research questions were answered using mean and standard deviations. The finding revealed that students taught using Computer Simulation Strategy performed better than those taught using the conventional teaching methods. Also the result of ANCOVA test indicate that there was significant difference in the achievement scores with (F=125.037; P= 0.00 $< \alpha$ = 0.05 and retention scores with F= 181.277; P=0.000 α =0.05) in favour of the group taught using computer simulation strategy. Based on this result, It was recommended that computer simulation strategy should be adopted for teaching of Biology in secondary schools, Science Teachers Association of Nigeria (STAN) should organize seminars, conferences and workshops to enlighten teachers on the effectiveness of CSS, the Federal Government through the Ministry of Education should ensure that teachers are trained on the use of computer simulation strategy to enable them use the CSS in teaching and learning of Biology so as to improve on the students' achievement and retention in sexual reproduction in plants and related topics in Biology and that computer simulation be employed in teaching Biology in Niger State secondary schools.
Keywords: Computer Simulation, Conventional Teaching method, Retention, Achievement

INTRODUCTION
Teaching of biology in line with the prescription in the core curriculum is a major challenge to Biology teachers. The Nigerian Biology curriculum is designed to be activity oriented and student-centered and the contents and contexts of Biology syllabus for secondary schools was intended to provide modern Biology course as well as meet the needs of the society through relevance and functionality in its contents, methods, processes and application (Ureigho et al. 2005; Ezeh (2007). The national policy statement notes that Biology teaching should emphasize adequate laboratory and field skills, meaningful and relevant knowledge to everyday life in matters of personal and community health and Agriculture, while ensuring reasonable and functional scientific attitude. Therefore, emphasis is laid more on teaching and learning of Biology as a process rather than as a body of knowledge. For this reason, field studies, guided discovery and laboratory technique and skills were

recommended. To ensure the full realization of these interesting objectives, the contents and contexts of the syllabus place great emphasis on field studies, guided discovery, laboratory techniques and skills coupled with conceptual thinking. Unfortunately, researches have revealed that, Biology teachers employ conventional teaching method in teaching biology in most secondary schools in the country (Awotua-Efebo, 2011).

This use of conventional teaching method in teaching Biology may not be unconnected with numerous challenges faced by Biology teachers in the class room, the challenges range from how to properly teach the abstract biological concepts for effective understanding to how to cover the syllabus as there are so many topics in Biology. Therefore, teachers always try to explain everything in detail as dictated by the curriculum and many students cannot connect the topics to each other and comprehend the knowledge. Hence, students are introduced to many concepts, terms, or information in too short a time using conventional teaching method which contradicts the nature of Biology curriculum (Killerman, 1998 in Nkok 2019)

Conventional teaching method is defined as a teaching method in which the teacher takes full control of the classroom by delivering an already prepared lesson as facts to the students who only listen and take note without being actively involved in the learning process (NERDC, 2008).

According to WAEC Chief Examiner's report (2018), there are indications that candidates who sat for the WAEC Examination in Biology exhibited numerous difficulties ranging from inability to properly interpret questions, failure to write or answer questions logically, systematically, and convincingly, poor drawing skills, poor power of expression, inability to relate features to functions, inability to spell many Biological terms correctly, poor understanding of sexual reproduction in *Rhizopus* and poor crossing of genetics expression. This indicates that candidates have a number of problems associated with both cognitive and motor skills which have culminated in the poor performance of students in the certificate examinations. The concept "sexual reproduction in plant" was chosen in this study as it is one of the topics that students hardly attempt question correctly from. (WAEC 2018-2020)

These problems can be traced to the use of ineffective teaching method (the conventional teaching method) in teaching Biology which does not promote retention. According to Iji (2012) retention in Geometry is not acquired by mere rote learning but through appropriate instructional delivery approach. Therefore, using a variety of instructional approaches can significantly help the learner to recall as much as he can of the skills he has acquired. Improved teaching strategies which comprises of virtual teaching strategies might stimulate students' interest in learning thereby helping them understand and retain the concepts of Sexual Reproduction in Plants which might result to higher achievements in the external examinations. Therefore, it is important to investigate virtual learning strategies to ascertain their effects on students' retention in Biology. This research therefore investigated one of the virtual learning strategies, (Computer Simulation Strategy) to ascertain its effect on students' retention in Sexual Reproduction in plants in senior secondary schools in Niger state, Nigeria. According to Thompson, Simonson and Hargrave (1996) Computer simulation is defined as a representation or model of an event, object, or some phenomenon. In science education a computer simulation strategy according to Akpan and Andre (1999) is the use of the computer to simulate dynamic systems of objects in a real or imagined world. Computer simulation models are simulation models that can bring into the classroom, aspects of the world or universe that are too expensive, dangerous, difficult, too slow or too fast in occurrence to be experienced firsthand. In Biology classrooms, simulation can play an important role in creating virtual experiments and inquiry (Alessi and Trollip, 1991). Emerging picture from evidence (WAEC 2018 -2020) shows that there has been poor achievement in Biology particularly in sexual reproduction in plants, the situation is worrisome because Biology is a subject that is a prerequisite to many professional courses in science and technology. The implication of the poor achievement is that there will be poor enrolment into science and technology courses, which will lead to the dwindling of man power in this area. This poor achievement can be traced to a lot of factors like students' lack of interest in the learning process and poor retention due to the application of ineffective teaching strategies, improved teaching strategy might help reverse this trend of poor achievement. This study therefore investigated the effect of computer simulation teaching strategy on students' achievement and retention of sexual reproduction in plants in Niger State, Nigeria

Research Questions
The following research questions were raised to guide the study:

1) What are the differences in the mean achievement scores of students taught Sexual Reproduction in Plant with Computer Simulation Strategy and those taught with Conventional Teaching Method?
2) What are the differences in the mean retention scores of students taught Sexual Reproduction in Plant with Computer Simulation Strategy and those taught with Conventional Teaching Method?
3) What are the differences in the mean achievement scores of male and female students taught Sexual Reproduction in plant with Computer Simulation Strategy?
4) What are the differences in the mean retention scores of male and female students taught Sexual Reproduction in Plant with Computer Simulation Strategy?

Hypotheses
The following hypotheses, were formulated and were tested at 0.05 level of significance:

$H0_1$ There is no significant difference between the mean achievement scores of students taught Sexual Reproduction in Plants   using Computer Simulation Strategy (CSS) and those taught with the Conventional Teaching Method (CTM)

$H0_2$: There is no significant difference between the mean retention scores of students taught Sexual Reproduction in Plants using Computer Simulation Strategy and those taught with the CTM

$H0_3$ There is no significant difference between the mean achievement scores of male and female students taught Sexual Reproduction in Plants with Computer Simulation Strategy

$H0_4$ There is no significant difference between the mean retention scores of male and female

METHODOLOGY
This study adopted a quasi-experimental non-equivalent control group design of pretest, post-test and post posttest type. Two intact classes received treatment and another two intact classes served as control group. The population of the study consisted of all the 240 public co-educational senior secondary school class two (SSII) Biology students in Niger State in 2018/2019 academic session. There were 11275 Biology students, 5903 males and 5372 females. The sample for the study consisted of 178 students in four coeducational public senior secondary schools in Minna educational zone of Niger State. The sampled students made up of 94 males and 84 females. The instrument used for data collection in this study was Plant Reproduction Achievement Test (PRAT): which was first used for pretest and post-test after the treatment, the instrument was later reshuffled and re-administered on the research subjects after four weeks, the scores obtained from the last administration served as post post-test scores (retention scores). Both the developed computer simulation instructional package on sexual reproduction in plants and Plant Reproduction Achievement Test (PRAT) were dully validated by experts. The reliability Test of (PRRT) was determined using split half reliability method and a reliability index of 0.88 was obtained. The research questions were answered using mean and standard deviation. The hypotheses were tested using Analysis of Covariance (ANCOVA) using Statistical Package for Social Sciences (SPSS). The significance of the various statistical analyses was ascertained at 0.05 alpha levels.

RESULTS

The findings were presented in Tables 1 to 8.

Research question 1: *What is the difference in the mean achievement scores of students taught Sexual Reproduction in Plant with Computer Simulation Strategy and those taught with Conventional Teaching Method?*

Table 1 Means and standard deviation of achievement scores in PRAT of students taught sexual reproduction in plants using CSS and those taught using CTM

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	17755.308a	2	8877.654	63.363	.000	.420
Intercept	360267.804	1	360267.804	2571.367	.000	.936
Group	**N**	**Mean**	**SD**	**Mean**	**SD**	
CSS	81	22.57	10.07	78.82	11.355	
CT M	97	30.54	32.302	59..52	12.71	

Table 1 shows the difference in the mean gain achievement scores of students exposed to Computer Simulation Strategy (CSS) and Conventional Teaching Method. The CSS has higher mean gain achievement score of 59.52 and CT M has a lower mean gain achievement score of 3.54.

HO$_1$ There is no significant difference between the mean achievement scores of students taught using Computer Simulation Strategy (CSS) and those taught using the Conventional Teaching Method (CTM)

Table 2:   Results of ANCOVA on Students' Achievement Scores in PRAT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	17755.308^a	2	8877.654	63.363	.000	.420
Intercept	360267.804	1	360267.804	2571.367	.000	.936
Pretest	1312.803	1	1312.803	9.370	.003	.051
Group	17518.661	1	17518.661	125.037	.000	.417
Error	24518.810	175	140.107			

Table 2 shows the result of ANCOVA of posttest scores as the dependent variable with the pretest as the covariate used in the analysis. From the table, the result from the groups revealed that there is significant difference between the mean achievement scores of students taught sexual reproduction in plants in the experimental and control group. This is from the fact that F-ratio= 125.037 and P- value = 0.00. Since the P-value of 0.00 is less than 0.05, this indicates a significant difference suggesting that we reject the null hypothesis value of 0.340 which is greater than the bench mark p- value of 0.05. This indicates that there is no significant difference in the mean retention score of male and female students taught using CSS. Since a significant difference has not been observed, the null hypothesis was not rejected. Gender did not produce a significant effect on the posttest retention scores of students. This shows that both male and female students taught sexual reproduction in plants with computer simulation strategy retained the lesson equally.

Research Question 2: *What is the difference in the mean retention scores of students taught sexual reproduction in plant with Computer Simulation Strategy and those taught with conventional teaching method?*

The result to answer this research question is presented in Table 3.

Table 3: Means and standard deviations of retention scores in PRAT of students taught Sexual Reproduction in Plants using CSS and those taught using CTM

Group	N	Pre- test		Post- test	
		Mean	**SD**	**Mean**	**SD**
Computer Simulation	80	79.06	11.226	78.96	11.223
Conventional Method	97	59.52	12.714	38.98	9.947

Table 3 shows the difference in the mean retention scores of students exposed to CSS and CTM. The CSS group has a retention scores of 78.96 and CTM has the lower retention scores of 38.94.

Table 4 shows a significant difference between the methods of instruction on retention. F-ratio = 181.277 and P-value = 0.000. Since P-value of (0.000) was less than 0.05 set as level of significance, the null hypothesis was rejected. The result implies that the learning strategies produced significant effects on the retention scores of students when covariance effect (posttest) was controlled.

HO2: There is no significant difference between the mean retention scores of students taught using Computer Simulation Strategy and those taught with the CTM

Table 4: Result of ANCOVA on Students' Retention Scores in PRAT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	79470.078[a]	3	26490.026	451.997	.000	.886
Intercept	1313.669	1	1313.669	22.415	.000	.114
Posttest	9268.973	1	9268.973	158.156	.000	.476
Group	21248.086	2	10624.043	181.277	.000	.676
Error	10197.563	174	58.607			

Research Question 3: *What is the difference in the mean achievement scores of male and female students taught Sexual Reproduction in Plants with Computer Simulation Strategy?*

The mean achievement scores and standard deviations of male and female students taught with CSS are presented in table 5;

Table 5; Mean and standard deviations of achievement of male and female students taught sexual reproduction using CSS

Gender	N	Pre-Interest		Post- Interest	
		Mean	**SD**	**Mean**	**SD**
Male	45	22.30	11.270	78.41	10.994
Female	36	22.90	8.336	79.33	11.928

Table 5 shows mean achievement scores of male and female students exposed to Computer Simulation Strategy. The female students have a higher mean achievement score of 79.33 while the male students have a lower mean achievement score of 78.41.

H0₃: There is no significant difference between the mean achievement scores of male and female students taught with Computer Simulation Strategy.

Table 6: Result of ANCOVA on Students' achievement in PRAT based on gender and CSS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1993.557[a]	2	996.788	Corrected Model	1993.557[a]	2
Intercept	60072.408	1	60072.408	Intercept	60072.408	1
Pretest	1976.567	1	1976.567	Pretest	1976.567	1
Group	7.755	1	7.755	Group	7.755	1
Error	8321.078	78	106.680	Error	8321.078	78

Table 6 shows an F=ratio 0.073 and P- value of 0.788 which is greater than the bench mark p-value of 0.05. This indicates that there is no significant difference in the mean achievement scores of male and female students exposed to Computer Simulation Strategy

Research Question 4; *What is the difference in the mean retention scores of male and female students taught sexual reproduction in plant using CSS?*

The mean retention scores and standard deviation scores of male and female students taught sexual reproduction in plants with Computer simulation are presented in Table 5

Table 7; **Mean Retention Scores of Male and Female Students Exposed to CSS**

Gender	N	Pre-test		Post- test	
		Mean	**SD**	**Mean**	**SD**
Male	45	78.41	10.994	78.73	11.613
Female	36	79.33	11.928	78.71	11.198

Table 7 shows mean retention scores of male and female students exposed to Computer Simulation Strategy. The male and female students have mean retention scores of 78.73 and 78.71 respectively.

H0$_4$; There is no significance difference between the mean retention scores of male and female students taught using Computer Simulation Strategy. The test for this hypothesis provided the data on Table 8.

Table 8; Result of ANCOVA on Students' retention scores in PRAT based on gender and CSS

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8993.377[a]	2	4496.688	263.691	.000	.871
Intercept	40.749	1	40.749	2.390	.126	.030
Posttest	8993.364	1	8993.364	527.382	.000	.871
Gender	15.704	1	15.704	.921	.340	.012
Error	1330.123	78	17.053			

a. R Squared = .871 (Adjusted R Squared = .868)

DISCSSION OF FINDINGS

The results of achievement reveal significant difference between the achievement of students in Computer Simulation Strategy and Conventional Teaching Method in favour of Computer Simulation Strategy. The result of students' achievement based on gender shows that there is no significant difference in achievement of male and female students in the experimental and control groups. This finding is in agreement with the findings of Dutsina Tanbayal and Sabitu (2016) who observed that gender has no significant effect in the achievement of students. But in disagreement with findings of Wangu (2014), Kashu (2014), Anih and Egbo (2015) who observed that gender has significant effect on students' achievement as male students did better than the female students in science, and identified teachers' attitude toward female students, teaching method and inferiority complex in girls to be responsible for the difference in the achievement level between boys and girls in biology classrooms. The findings on students' achievement in the Computer Simulation Strategy group compared to those in Conventional Teaching Method group are in agreement with the earlier findings of Efe and Oladikan and Oladele (2016), Asogwa,,Muh'd, Asogwa and Ufoegbu (2016), Falode and Bashir (2015), Ezeudu and Ezinwanne (2013), Aoudu (2015), Flangovan (2014) and Fabiku (2016) Liao and Chan (2013), Thong (2014), Asogwa and Ufoegbu (2016) who found out that students taught sciences using Computer Simulation achieved better than those taught using the Conventional teaching methods. This also agrees with the findings of Bayrak (2014) Sarabandoa, Cravinob, Armando and Soaresb (2014) Mihindo, Wachanga, and. Anditi (2016) Asogwa,,Muh'd, Asogwa and Ufoegbu (2016), who reported that students taught with computer simulation Strategy achieved better than those taught using the conventional methods. The trend of improved achievement by the experimental groups could be as a result of the enabling learning environment provided, where students use the Computer Simulation Instructional Package on sexual reproduction in plants which is an interactive package with students' activities and step by step assessment which help the students to master the concept of sexual reproduction in plants easily. It could also be as a result of excitement over the new learning approach, handling of personal computers, and the elimination of bias and strained relationship between teachers and students

The findings on the retention rate shows significant difference between the retention of students exposed to Computer Simulation Strategy and Conventional Teaching Method. The findings on students' retention under Computer Simulation Strategy and Conventional Teaching Method is in agreement with the findings of Mihindo, Wachanga, and Anditi (2016), who reported that Computer simulation enhances students' retention in biology, it is also in agreement with Gimba, Falode and Bashir (2015), Ezeudu and Ezinwanne (2013) which asserted that students taught biology with computer Simulation retained the concepts better than those taught with conventional method. Thus, students exposed to Computer Simulation Strategy performed better than those exposed to Conventional Teaching Method. This can be explained by the excitement and commitment of students to the instructional process. These findings have proved the efficacy of the social constructivists' view of learning in bringing about meaningful learning as it gives students the opportunity to construct their own meaning, thus making them active processors of knowledge rather than the passive nature of students in the Conventional Teaching Method. This could have made learning more exciting, interactive and sustained the students' interest on the lesson. The findings on retention based on gender shows no significant difference in the retention of male and female students in the experimental group. This finding is in agreement with the report of Oladikan and Oladele (2016), Asogwa,Muh'd, Asogwa and Ufoegbu (2016), Ezeudu and Ezinwanne (2013) which concluded that, gender has no significant effect on male and female retention ratings when taught using Computer Simulation Strategy

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