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Effect of Interactive Computer Simulation Package on Senior Secondary School Students Achievement and Retention in Genetic Concepts

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Abstract: This study investigated the effects of computer simulation instructional packages on senior secondary school students' achievement and retention in genetic concepts. The study adopted a pretest posttest quasi-experimental design with non-equivalent groups. Four research questions were formulated to guide the study. Four null hypotheses were posed and tested at 0.05 level of significance. The population of the study was all the 8,109 Biology students in Gombe central education zone, Gombe state, Nigeria. The sample of the study constituted 121 students derived from the two purposively selected co-educational Senior Secondary Schools in the study area. Data was collected using Genetic Achievement Test (GAT) and Genetic Retention Test (GRT). Mean and standard deviation were used in answering the research questions while Analysis of covariance was used to test the null hypotheses. The study revealed that interactive computer simulation instructional package has significant effect on improving students' achievement and retention in genetic concepts than computer simulation package without interaction. The result also revealed that gender has no significant effect on students' achievement and retention in genetic concepts when exposed to either of the packages. It was recommended that Biology teachers should adopt the use of interactive computer simulation instructional packages for teaching genetics in senior secondary schools.

Key words: Interactive computer simulation package, academic achievement, retention, genetic concepts, senior secondary schools

INTRODUCTION

Science education is a veritable tool for scientific and technological advancement of any nation. This fact is enshrined in the national policy on education (Federal Republic of Nigeria, 2004) which states that science education should among other things equip students to live effectively in the modern age of science and technology. The policy also emphasised Science teaching and learning as an instrument for inculcating necessary scientific knowledge, skills and competencies. Biology is among the science subjects offered in Nigerian secondary schools. Biology is a branch of science that involves the systematic study of living things. It is a fascinating study that ranges from microscopic cellular molecules to the biosphere, encompassing the earth surface and all living organisms. The Biology curriculum for secondary schools as outlined in the 2008 curriculum document is designed to prepare students to acquire: adequate laboratory and field skills in Biology; meaningful and relevant knowledge in Biology; ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture and reasonable and functional scientific attitudes (Federal, 2009).

Biology is recognised as one of the core science subjects offered at the senior secondary schools level in Nigeria. Biology is the most preferred science subject both among science and non-science students. This is attested by large students' enrolment for the subject in West African Senior Secondary Certificate Examination SSCE (Nsofor, 2001). Biology is a requirement for further learning in many science related courses namely; Medicine, Anatomy, Pharmacy, Zoology, Botany, Cytology, Embryology, Genetics, Neurology, Parasitology and Agricultural Science among others. The knowledge of Biology in its applied form has found various applications in industries like: food manufacturing, processing and preservation, crime detection through the use of finger print, population control through the use of family planning, disease control in medical field, development of vaccines and

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drugs, organs transplanting, plants and animals hybridization, development of pesticides, to mention but a few.

Biology as a science of life provides knowledge on genetic makeup through gene marking and gene transfer. For instance, women who are assumed to be barren have been able to produce children with assistive technologies like *In Vitro* Fertilization (IVF); Intra-Uterine Insemination (IUI); Tubal Drop Insemination (TDI) and testube babies or clones thus, making couples have children without necessarily having physical sexual contact. Topics taught under Biology that are designed to achieve the objectives of Biology include; ecosystem, microorganisms, tissues and systems, ecology, evolution and genetics which is a variable of interest for this study.

Genetics is an important topic in Nigerian secondary schools Biology SS III curriculum. Genetics is a branch of Biology that study heredity, variation, functions and behaviours of genes, chromosomes etc. The sub themes found under genetics as highlighted by Ramalingam include: principles of heredity, the transmission of inheritable characters from parents to their offspring via genes and variation; differences that occur within the individuals of specie. The principles of heredity are used extensively in hybridization technology, genetic engineering, crops and animals improvements, counselling for genetic disorders, Rhesus factor, genetic therapy among others. Global collaboration on human genome project is evidence that international community has placed importance on the study of genetics. The objective of the human genome project is to analyse human genes in which mutation will lead to disease. The recommendations from human genome project could promote advances in prevention, diagnosis and provision of therapy of genetic disorders like sickle cell anaemia, albinism, colour blindness among others.

Despite the popularity and the numerous applications of Biology and genetics in particular to all areas of human endeavours, it is unpleasant academically to note that most students' performance in Biology at the school certificate level in Nigerian secondary schools is rapidly declining. The performance of science students in the examinations conducted national examination bodies at the senior secondary school level has been disheartening especially in Biology which has the highest enrolment rate among the sciences. Evidently, poor academic performance of secondary school students in Biology seems to have risen in recent history. This observation is supported by West African Examination Council (WAEC) Chief Examiners Reports in five consecutive years. The WAEC Chief Examiner's Report Nov/Dec. 2012 reported the mean score of 21 and the standard deviation of 8.71 which is slightly poorer than that of 2011 with a mean score of 22 and standard deviation of 7.22. Similarly, the report of May/June 2012 was poorer than that of previous year comparing the mean score of 16 and standard deviation of 0.906 with the mean score of 19 and standard deviation of 9.54 for the May/June 2011.

The desire to know and understand the causes of students' poor performance in genetics has attracted the attention of researchers in recent times (Shihusa and Keraro, 2009). A considerable number of those researches have been carried out in order to find out the causes of poor performance in genetics. Some of the problems identified include: poor teaching methods, inadequate number of qualified Biology teachers, poor infrastructures, inadequate laboratory facilities, abstract nature of some concepts, teacher-centred instruction and non-availability and utilisation of instructional materials. These findings have led to the conclusion that science subjects especially Biology has not been given the desired attention in Nigerian Secondary Schools. As a result, there are needs for an attempt to find alternative and more appropriate methods for Biology instructions since teacher`s methods of teaching could be a detriment to effective teaching and learning of Biology especially in genetics. A teacher is expected to be a facilitator of learning. Teachers use methods and materials that will help them to communicate to students effectively. The utilisation of appropriate instructional materials and methods in the classroom could narrow the gap of complexity and abstractness of concepts.

Instructional materials are educative medium used to facilitate teaching-learning process for the achievement of educational goals and objectives in an efficient manner. These instructional materials include charts, models, mock-up and computers among others. These instructional materials have undergone numerous modifications from time to time. Efforts have been made to improve instructional materials by the introduction of a wide variety of instructional materials such as computers and other electronic devices. Indeed, using computers in classrooms as an instructional media in Nigerian secondary schools is among the recent phenomenon which is now becoming common and widespread.

Computer is a special multi-purpose device that is capable of receiving instructions, storing, processing and giving a desired result at an incredible high speed. According to Bakac *et al.* (2011), computer can be used as an instructional material or technique that can assist teachers to make instructions more effective, flexible and enjoyable. Computer provides equivalent opportunities

for all learners to interact with the learning process while taking into account the individual differences among learners with characteristics that appeal to more than one sense at a time. Computers can be used for instructional purpose in different modes such as tutorial mode, drill and practice, simulation modes, play methods etc. As a result, computers are employed in modern teaching techniques to assist teachers to overcome challenges of student's poor achievement in Science related subjects; hence the name Computer Assisted Instruction (CAI). Computer Assisted Instruction (CAI) packages usually present information using the combination of text, sounds and moving images. These attributes of CAI make it a multimedia package that should be seen as a revolution for education in the way information for learning is being communicated to the learner, this puts information in a more relevant and meaningful perspective. CAI packages include the modes: drills and practice, tutorials, games and simulation. The key aspect of these CAI packages is that they apply to more than one sense simultaneously as it addresses the sense of sight and hearing which could make learning more effective and engaging.

Interactive simulation is the simulation package that presents information in step by step with time interval for the clarifications and digestion of the simulated concepts between the teacher and students. According to Dwyer and Lopez, interactive simulation helps students to identify and understand factors which control the system and predict the future behaviour of the system. Interactive computer simulations can be applied in teaching process because it provides real life setting of abstract concepts and their explanation. Interactive Simulation encourages students to become active participants in the learning process. Simulation could substitute and imitate original or a display of non-real behaviour and allow learners to manipulate screen "objects" for exploring underlying concepts, they can also learn with the observation and manipulation of tools in the simulated world.

Learning is said to have occurred when what is learnt remains relatively permanent in the mind of the learner. Hence, retention of what is learnt by students is very important. Retention is the capability to replicate the concept learnt when need be. It is the reproducibility of the learned behaviour by the learner elicited following a time interval. Therefore, a learner who repeats an acquired piece of knowledge with less error is said to have retained the material learnt. Similarly, when what is learnt is not retained or fades with time learning becomes inconsistent. Exploring mode of lesson delivering which could help students to retain materials learnt becomes absolutely important. For this therefore, it has become necessary to determine the effect of computer simulation package in enforcing learning retention in genetic concepts.

The issue of gender is an important aspect in science education especially with increasing emphasis on ways of boosting manpower for technological development as well as increasing the population of females in science and technology fields (Ogunkola and Bilesamni, 2000). In Nigeria and perhaps the whole of Africa, gender bias is still very prevalent (Arigbabu and Mji, 2004). This is a view to which Onyeizugbo (2003) has alluded by pointing out that sex roles are rigid in Africa more especially in Nigeria. Gender stereotype is common in the day-to-day life of an average Nigerian more especially in the northern part of the country. Therefore, influence of gender also poses a problem in relation to student's achievement in Biology. Results from research findings have revealed inconsistencies in achievement of male and female students in physics, chemistry and Biology generally (Patrick and Ezenwa, 2000).

Statement of the problem: Gombe state is recognized as one of the educationally disadvantaged state in Nigeria with persistent student's poor performance in sciences (Usman, 2010). The West African Examination Council Chief Examiners Reports revealed that candidate's performance in Biology in the state is poor. The poor performance of students in Biology at the senior secondary school is more pronounce under genetics. This was confirmed by WAEC chief examiners report that most students in the state are not attempting questions related to genetics and those who do, failed those questions. The insubstantiality of the genetic concepts made the concepts very difficult to retain even if they were understood by the students. Therefore, retention of the concepts is also poor. Genetics is considered difficult to teach and difficult to learn to the extent students typically dislike it as they find it confusing and boring. This state of affairs is worrisome if allowed to linger. Therefore, there is need to test newer modes of instructional delivery to see weather students' achievement in the subject will improved in the state. Hence; this study investigates effect of computer simulation packages on senior secondary schools students' achievement and retention in genetic concepts.

Purpose of the study: The major purpose of this study was to determine the effects of two modes of computer simulation instructional packages on senior secondary school students' achievement and retention in genetic concepts.

Specifically, this study seeks to determine the effects of interactive computer simulation instructional package and computer simulation instructional package without interaction on students achievement in genetic concepts:

- Determine the influence of gender on academic achievement of secondary school students taught genetic concepts using interactive computer simulation instructional package
- Determine the effects of interactive computer simulation instructional package and computer simulation instructional package without interaction on students retention in genetic concepts
- Determine the influence of gender on the retention of students taught genetic concepts using interactive computer simulation instructional package

Research questions: The following research questions will guide the study:

- What are the mean achievement scores of students taught genetic concepts using interactive computer simulation instructional package and those exposed to computer simulation instructional package without interaction?
- What are the mean achievement scores of male and female students taught genetic concepts using interactive computer simulation instructional package and those exposed to computer simulation instructional package without interaction?
- What are the mean retention scores of students taught genetic concepts using interactive computer simulation instructional package?
- What are the mean retention scores of male and female students taught genetic concepts using interactive computer simulation instructional package?

Research hypotheses: The following null hypotheses are formulated for the study and will be tested at 0.05 level of significance:

- HO_1: There is no statistically significant difference between the mean achievement scores of students taught genetic concepts using interactive computer simulation instructional package and those taught the same concepts using computer simulation package without interaction
- HO_2: There is no statistically significant difference between the mean achievement scores of male and female students taught genetic concepts using interactive computer simulation instructional package
- HO_3: There is no statistically significant difference between the mean retention scores of students taught genetic concepts using interactive computer simulation instructional package and those taught the same concepts using computer simulation package without interaction
- HO_4: There is no statistically significant difference between the mean retention scores of male and female students taught genetic concepts using interactive computer simulation instructional package

MATERIALS AND METHODS

This study adopted pre-test post-test quasi experimental control group design using non-equivalent groups. The design was chosen because it controls the internal validity threats of the initial group equivalence and researchers selection bias, since there was no randomisation of the subjects. Intact classes were used for the study.

The population of the study comprises of all the 8,109 SSIII students from 19 co-educational senior secondary schools in Gombe central education zone of Gombe. The sample for this study comprises 121 students derived from two intact classes of the selected co-educational senior secondary schools from the study area using purposive sampling. Purposive random sampling was used to obtain the two senior secondary schools that have well equipped computer laboratory. Simple random sampling technique was used to draw one intact class from the two schools and in assigning them into treatment groups.

The research instruments were the Genetic Achievement Test (GAT) and Genetic Retention Test (GRT). The GAT consists of two sections, the first section is personal data and instructions while the second section is 30 multiple choice items. The items cover different levels of understanding based on Bloom`s Taxonomy of Educational Objectives and was administered to students as pre-test and post-test. GRT was delayed post-test used to determine the level of retention of the concepts taught. It consist of four topics with eight lessons and was administered as treatment instruments.

The GAT was validated for face and content validity by two experts in educational technology, an expert in Measurement and Evaluation, an expert from Biological Science Education. The reliability of the instruments was determined by the pilot test method using Pearson Product Moment Correlation (PPMC). The reliability coefficient (r) 0.91 was obtained. The packages, Interactive Computer Simulation Package (ICSP) and Computer Simulation Package (CSP were also subjected to face validation.

Experimental procedures: The researchers sought the official permission from the authorities to use their schools for the study. Biology teachers were used as research assistants and were trained on the procedure for carrying out the experiment in a week. The study covered

a period of nine weeks. During the first week, pre-test was administered to all the selected students in the two schools to determine the equivalence of the groups. The actual teaching for all the groups lasted for four weeks. The experimental group 1 was taught using ICSP while the experimental group 2 was taught with CSP. Each class has two periods of 80 min per week as provided in the time tables.

Thereafter, GAT was shuffle and administered to all the groups as post-test. About 2 weeks later, the items in the genetic achievement test was reshuffled and administer to all the groups as Genetic Retention Test (GRT). The entire tests administered (pre-test, post-test and retention test) in both the experimental and control groups was marked over 30 for the thirty items by the researchers. The scores were used for data analyses.

Mean and standard deviation was used to answer the research questions posed for the study and Analysis of Covariance (ANCOVA) was used to test the hypotheses formulated for the study at 0.05 level of significance.

RESULTS

Research question one: What are the mean achievement scores of students taught genetic concepts using interactive computer simulation instructional package and those taught the same concepts using computer simulation package without interaction? The result is presented in Table 1.

Results in Table 1 show that the group taught genetics using interactive computer simulation package had a pre-test mean of 8.19 with a standard deviation of 3.38 and a post-test mean of 23.63 with a standard deviation of 3.57 The difference between the pre-test and post-test mean was 15.44. The group taught genetics using computer simulation package without interaction had a pre-test mean of 6.88 with a standard deviation of 3.51 and a post-test mean of 20.12 with a standard deviation of 2.47. The mean gain was 13.24. However, for each of the groups, the post-test means were greater than the pre-test means with the group taught using interactive computer simulation package having a higher mean gain. This shows that interactive computer simulation package is more effective in teaching students genetic concepts than the computer simulation package without interaction.

Research question two: What are the mean achievement scores of male and female students taught genetic concepts using interactive computer simulation instructional package? The result is presented in Table 2.

Table 1: Mean achievement scores and standard deviation of students taught genetics with ICSP and CSP

	Pre-test			Post-test			
Variables	N	Mean (X)	SD	N	Mean (X)	SD	Mean gain
ICSP	63	8.19	3.38	63	23.63	3.57	15.44
CSP	58	6.88	3.51	58	20.12	2.47	13.24

Table 2: Mean achievement scores and standard deviation of male and female students taught genetics with ICSP

	Pre-test			Post-test			
Variables	N	Mean (X)	SD	N	Mean (X)	SD	Mean gain
Male	35	8.97	3.61	35	23.40	3.89	14.43
Female	28	7.21	2.83	28	23.93	3.17	16.72

Table 3: Mean retention scores and standard deviation of students taught genetics with ICSP and CSP

	Post-test			Retention-test			
Variables	N	Mean (X)	SD	N	Mean (X)	SD	Mean loss
ICSP	63	23.63	3.57	63	22.08	3.10	-1.55
CSP	58	20.12	2.47	58	15.62	2.92	-4.50

Result in Table 2 shows the influence of gender on students' achievement in genetics when taught using interactive computer simulation package. Result shows that the male students had a pre-test mean of 8.97 with a standard deviation of 3.61 and a post-test mean of 23.40 with a standard deviation of 3.89. The difference between the pre-test and post-test mean for the male students was 14.43. The female students had a pre-test mean of 7.21 with a standard deviation of 2.83 and a post-test mean of 23.93 with a standard deviation of 3.17. The mean gain was 16.72. However, for each of the groups (i.e., male and female), the post-test means were greater than the pre-test means with the female students having a higher mean gain. This indicates that female students achieve more in genetics when taught using interactive computer simulation package than their male counterparts.

Research question four: What are the mean retention scores of students taught genetic concepts using interactive computer simulation instructional package and those taught the same concepts using computer simulation package without interaction? The result is presented in Table 3.

Table 3 shows the mean retention scores and standard deviations of students taught genetic concepts with two modes of presentation of the instructional packages (Interactive Computer Simulation Package (ICSP) and Computer Simulation Package without interaction (CSP). Results in Table 4 show that the group taught genetics using interactive computer simulation package had a post-test mean of 23.63 with a standard deviation of 3.57 and a retention test mean of 22.08 with a standard deviation of 3.10. The difference between the

Table 4: Mean retention scores and standard deviation of male and female students taught genetics with ICSP

	Post-test			Retention-test			
Variables	N	Mean (X)	SD	N	Mean (X)	SD	Mean loss
Male	35	23.40	3.89	35	22.23	3.63	-1.17
Female	28	23.93	3.17	28	21.89	2.33	-2.04

post-test and retention test mean was -1.55. The group taught genetics using computer simulation package had a post-test mean of 20.12 with a standard deviation of 2.47 and a retention test mean of 15.62 with a standard deviation of 2.92. The difference between the post-test and retention test means was -4.50. However, for each of the groups, the retention test means were less than the post-test means with the group taught using interactive computer simulation package having a lower mean loss. This is an indication that interactive computer simulation package help students retain genetics concept more than the computer simulation package without interaction.

Research question four: What are the mean retention scores of male and female students taught genetic concepts using interactive computer simulation instructional package? The result is presented in Table 4.

Results in Table 4 show the influence of gender on students' level of retention in genetics when taught using interactive computer simulation package. Results show that the male students had a post-test mean of 23.40 with a standard deviation of 3.89 and a retention test mean of 22.23 with a standard deviation of 3.63. The difference between the post-test and retention test mean for the male students was -1.17. The female students had a post-test mean of 23.93 with a standard deviation of 3.17 and a retention test mean of 21.89 with a standard deviation of 2.33. The difference between the post-test and retention test mean was -2.04. However, for each of the groups, (i.e., male and female), the retention test means were less than the post-test means with the male students having a lesser mean loss. This indicates that male students retain more in genetics when taught using interactive computer simulation package than their female counterparts.

Hypothesis one: There is no significant difference between the mean achievement scores of students taught genetic concepts using interactive computer simulation instructional package and those taught the same concepts using computer simulation instructional package without interaction. To test the null hypothesis one, an analysis of covariance between the means achievement scores of students taught with ICSP and CSP were computed and the result is shown in Table 5.

Table 5: Analysis of covariance of the significant difference in the mean achievement scores of students taught genetics with ICSP and CSP

Source	Sum of squares	df	Mean square	F-value	p-value
Corrected model	486.397[a]	2	243.199	27.989	0.000
Intercept	8037.404	1	8037.404	925.006	0.000
Covariate (Pre-test)	113.453	1	113.453	13.057	0.000
Main effect (Treatment)	287.651	1	287.651	33.105	0.000*
Error	1025.305	118	8.689		
Total	59812.000	121			
Corrected total	1511.702	120			

p<0.05*; Significant

Table 6: Analysis of covariance of the significant difference in the mean achievement scores of male and female students taught genetics using ICSP

Source	Sum of squares	df	Mean square	F-value	p-value
Corrected model	161.850[a]	2	80.925	7.722	0.001
Intercept	3378.596	1	3378.596	322.409	0.000
Covariate (pre-test)	157.504	1	157.504	15.030	0.000
Main effect treatment)	27.854	1	27.854	2.658	0.108*
Error	628.753	60	10.479		
Total	35983.000	63			
Corrected total	790.603	62			

p>0.05; *NS = Not Significant

The result in Table 5 shows the significant difference in the mean achievement scores of students taught genetics using ICSP and those taught using CSP. The result in respect to the groups taught genetics concepts ICSP and those taught using CSP, an F-ratio of 33.105 was obtained with associated probability value of 0.000. Since, the associated probability value of 0.00 was <0.05 set as level of significance, the null hypothesis ($H0_1$) which stated that there is no significant difference between the mean achievement scores of students taught genetic concepts using interactive computer simulation instructional package and those taught the same concepts using computer simulation instructional package is rejected. Thus therefore, the inference drawn is that there was a significant difference in the mean achievement scores of students taught genetics using ICSP and those taught using CSP with those taught using ICSP having a higher mean gain.

Hypothesis two: There is no significant difference between the mean achievement scores of male and female students taught genetic concepts using interactive computer simulation instructional package. The result is shown in Table 6.

The result in Table 6 shows that with respect to the mean achievement scores of male and female students taught genetics using ICSP, an F-ratio of 2.658 was obtained with associated probability value of 0.108. Since the associated probability value of 0.108 was >0.05 set as level of significance, the null hypothesis ($H0_2$) which stated that there is no significant difference between the mean achievement scores of male and female students taught genetic concepts using interactive computer simulation instructional package is not rejected. This

Table 7: Analysis of covariance of the significant difference in the mean retention scores of students taught genetics with ICSP and CSP

Source	Sum of squares	df	Mean square	F-value	p-value
Corrected model	1592.366[a]	2	796.183	124.999	0.000
Intercept	115.159	1	115.159	18.080	0.000
Covariate (post-test)	332.657	1	332.657	52.227	0.000
Main effect (treatment)	472.871	1	472.871	74.240	0.000*
Error	751.601	118	6.369		
Total	45949.000	121			
Corrected total	2343.967	120			

[a]p<0.05; *Significant

Table 8: Analysis of covariance of the significant difference in the mean retention scores of male and female students taught genetics using ICSP

Source	Sum of squares	df	Mean square	F-value	p-value
Corrected model	384.511[a]	2	192.256	54.388	0.000
Intercept	42.289	1	42.289	11.963	0.001
Covariate (post-test)	382.758	1	382.758	108.281	0.000
Main effect (treatment)	7.678	1	7.678	2.172	0.146*
Error	212.092	60	3.535		
Total	31309.000	63			
Corrected total	596.603	62			

[a]p>0.05; *NS = Not Significant

means that gender is not a significant factor in determining students' achievement in genetics when taught using ICSP.

Hypothesis three: There is no significant difference between the mean retention scores of students taught genetic concepts using interactive computer simulation instructional package and those taught the same concepts using computer simulation instructional package without interaction. The result is shown in Table 7.

The result in Table 7 shows the significant difference in the mean retention scores of students taught genetics using ICSP and those taught using CSP. The result in respect to the groups taught genetics concepts ICSP and those taught using CSP, indicates that an F-ratio of 74.240 was obtained with associated probability value of 0.000. Since, the associated probability value of 0.000 was less than 0.05 set as level of significance, the null hypothesis ($H0_4$) which stated that there is no significant difference between the mean retention scores of students taught genetic concepts using interactive computer simulation instructional package and those taught the same concepts using computer simulation instructional package with advance organizer is rejected. Therefore, there was a significant difference in the mean retention scores of students taught genetics using ICSP and those taught using CSP with those taught using ICSP having a lower mean loss. This shows that ICSP has more effect on students' retention in genetics than the CSP.

Hypothesis four: There is no significant difference between the mean retention scores of male and female students taught genetic concepts using interactive computer simulation instructional package. The result is shown in Table 8.

The result in Table 8 shows that the mean retention scores of male and female students taught genetics using ICSP. An F-ratio of 2.172 was obtained with associated probability value of 0.146. Since the associated probability value of 0.146 was greater than 0.05 set as level of significance, the null hypothesis ($H0_4$) which stated that there is no significant difference between the mean retention scores of male and female students taught genetic concepts using interactive computer simulation instructional package is not rejected. Thus, inference drawn therefore is that the mean retention scores of male and female students did not differ significantly when taught genetics using ICSP. This means that gender is not a significant factor in determining students' retention in genetics when taught using ICSP.

DISCUSSION

The result of the data analysed in table 1 showed that the two groups that were taught genetics using two modes of computer simulation packages ICSP and CSP have the mean achievement scores of 23.63 and 20.12, respectively. The results show that the group that was taught using Interactive Computer Simulation Package (ICSP) performed significantly better than the group taught using computer simulation package with advance organiser. The implication is that, ICSP has an enhancing effect on the teaching and learning of genetics more than CSP. It could be as a result teacher-students interaction in the delivery of ISCP to students. The finding is consistent with the basic tenet of constructivism which postulates that learners have an innate derive to make sense of their environment. Therefore, learners can build personal interpretations based on their prior learning experiences. The finding also is in line with operant conditioning theory which uses different techniques to ensure that learners link appropriate response to a particular stimulus through systematic designs of instructions. Similarly, it is evident that the developed ICSP on genetics stands to satisfy the demand of dual coding theory which suggests that learners learnt better from words, pictures and expository interaction between teachers and learners and among students. The findings on the influence of gender on the mean achievement scores of students taught genetics using ICSP as sought by research question two on Table 2 indicated that female students performed slightly (23.93) better than male students (23.40) when ICSP is used. The testing of the corresponding hypothesis two further revealed that there was no statistically significant difference in the achievement of male and female students. Thus, the null hypothesis two was accepted. This means that gender does not influence

students achievement when taught genetics with ICSP. The finding of this study contradict that of Patrick and Ezenwa who found statistical difference in the achievement of male and female students in Sciences.

The result in Table 4 showed that the two groups taught genetics using two modes of computer simulation packages ICSP and CSP have the mean retention scores of 22.08 and 15.62 respectively. The results show that the group that was taught using Interactive Computer Simulation Package (ICSP) retained the concepts significantly better than the group that was taught using computer simulation package with advance organiser This implies that ICSP enhanced students' retention of genetics concepts more than CSP. This high level of knowledge retention demonstrated by ICSP as against CSP may be attributed to the use of precession in presenting the concepts with verbal and pictorial illustration together with teacher clarifications which provided a concrete basis for conceptual thinking and therefore facilitate a better and proper understanding and retention of genetic concepts. The finding is in agreement earlier studies (Akpan and Andre, 2000; Ogunkola and Bilesamni, 2000; Okwo and Tartiyus, 2004) that computer simulation instructional packages increase students retention.

The findings on the influence of gender on the mean retention scores of students taught genetics using ICSP as sought by research question four on table 4 indicated that male students performed slightly better than their female counterpart when ICSP is used. The testing of the corresponding hypothesis further revealed that there was no statistically significant difference in the retention of male and female students. This means that gender has no effect on students retention when taught genetics with ICSP. The finding agrees with some studies (Akpan and Andre, 2000; Ogunkola and Bilesamni, 2000; Okwo and Tartiyus, 2004) that computer simulation instructional packages increase students retention irrespective of gender.

CONCLUSION

Based on the findings, the following conclusions were made: interactive computer simulation instructional packages have significant effect on students' academic achievement in genetics than computer simulation instructional package without interaction. Gender has no significant influence on students' achievement in genetics when Computer Simulation Instructional packages with interaction. Interactive computer simulation instructional package has significant effect on students' retention in genetics than computer Simulation Instructional Package without interaction. Gender has no significant influence on students' retention in genetics when computer simulation instructional packages with interaction. The following recommendations have been made based on the findings and conclusion of the study:

Interactive Computer Simulation Package (ICSP) because it inspires learners and develop their spirit of understanding and retention should be used in teaching genetic concepts.

Government and stake holder in education should make computer simulation instructional packages available in schools, educational resource centres, libraries and laboratories for teachers and students to make use of them because this finding has provided empirical evidence that ICSP are effective in bringing about better learning achievement and retention for all students irrespective of gender.

Government and development partners in education should provide more computers and computer accessories to schools and retrain the teachers on how to use computers for instructional purposes.

Teachers should be encouraged to be more resourceful, creative and innovative in developing, selecting and using the computer simulation packages relevant to a particular topic for effective teaching and learning

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