

EFFECTS OF COMPUTER GRAPHICS AND ANIMATION INSTRUCTIONAL MODES ON SECONDARY SCHOOL STUDENTS' INTEREST IN GENETICS

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ABSTRACT

There is a perceived trend of poor interest of students in genetics in Nigerian Secondary schools today. This situation has been attributed to many factors one of which is poor method of teaching. Against this background that this study determined the effects of computer graphics and animation instructional modes on secondary school students' interest in genetics. Three research questions were raised and three research hypotheses were formulated and tested at 0.05 level of significance. The research design was quasi - experimental. Three groups (two experimental and one control) made up of 135 senior secondary one (SS1) students were drawn from the population of 2,608 SSI students. Purposive random sampling was used to select three public secondary schools from Aguata Education Zone of Anambra state. One instrument was used for data collection namely, Genetics Interest Scale (GIS). Three experts validated the instruments. The instruments were trial tested and the GIS gave a reliability coefficient of 0.85. Before treatment was given they were pretested with the GIS. After five weeks of teaching they were post-tested with GIS. Mean and standard deviation were used to answer the research questions while Analysis of Co-variance (ANCOVA) was used to test the null hypotheses. The findings indicated that computer graphics and animation instructional modes had significant effects on the mean interest scores of students in genetics. Based on the findings, it was recommended among others that biology teachers should adopt the use of computer graphics and animation in the teaching of genetics in order to enhance the interest of students in genetics. Government and education authorities should sponsor biology teachers to workshops and seminars to learn how to improve their teaching skills using computer graphics and animation.

Biology is the study of life and evolution of organisms and their structures, processes and interactions with each other and their environment (Aloh & Afamah, 2013). It is taught at senior secondary school level in Nigeria and is introduced to students as a preparatory ground for human development where career abilities are groomed (Federal Republic of Nigeria, FRN, 2014). Biology is a prerequisite for pursuing a number of careers in science-based courses which include medicine, pharmacy, agriculture, biochemistry, botany, zoology among others. The importance of biology in the industrialization and other sector of the economy cannot be over emphasized. The aims and objectives of secondary school biology education as contained in the National Policy on Education (FRN, 2014) include to: develop an awareness of the environment, understand certain key biological concepts necessary for successful living in scientific and technological advancement, inculcate the habit of critical observation and drawing conclusions only on available data, illuminate the problems of sex, reproduction, growth, pollution, health etc for the benefit of the society, acquire the ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture as well as disperse superstitious beliefs in a technological method and also see one as an organism among a group whose processes influence and influenced by same.

Biology has many topics some of which are abstract and difficult for students to understand. Nzelum (2010) identified genetics, homeostasis, evolution, nervous co-ordination, ecology, cellular respiration among others as difficult topics in secondary school biology curriculum. In addition, Cimer (2012) noted that there are five topics in biology that are most difficult which are matter cycles, endocrine system and hormones, respiration, cell division, genetics and evolution. Genetics is an important aspect of biology that deals with heredity and variation. Umeh (2010) defined genetics as the science that deals with questions and answers on inheritance. An understanding of genetics is necessary for the diagnosis, prevention and treatment of hereditary diseases, the breeding of plants and animals and the development of industrial process through the use of micro-organisms. Genetics could be called a science of potentials since it deals with the transfer of information from parents to offspring. Genetics gives answers to such problems as incompatibility of blood groups, hereditary diseases like sickle cell anaemia, leukemia and others. Thus, the study of genetics gives the students the opportunity to explain most

naturally occurring phenomenon like birth of twins, sex determination, crops and livestock failures which were hitherto explained through superstition.

Despite the importance of genetics to man, it is one aspect of biology that most teachers find difficult to teach and students find it difficult to learn because of its abstract nature (Cimer, 2012). This is because it deals with inheritance of traits that can be visibly seen but the explanation is always inadequate as to how the process takes place. This implies that those things that are responsible for the transfer of the genes cannot be seen by the students. Consequently, students loss interest and performance of the students in such abstract concepts in senior school certificate examinations is poor (WAEC, Chief Examiner's report, 2015; 2017; 2018; 2019).The method used by teachers in teaching biology has been blamed for poor interest, achievement and retention of knowledge by the students. Several research reports (Anyaegbunam, 2012; Nworgu, 2009; Obiekwe, 2008) indicate that many science teachers prefer the conventional method of teaching and shy away from innovative, activity-oriented, learner-centered methods or strategies. According to Ezeudu (2011), conventional method is a discourse delivery method of instruction. The use of conventional method entails a one way flow of communication from the teacher to the students and it is economical in terms of time and effort. Conventional method leads to easy coverage of curriculum and allows for easy teaching of larger classes. However, despite the advantages of conventional method, it is still identified to be ineffective in promoting learning because of the following: conventional method encourages rote learning and favours passive reception of knowledge by students; students easily become restless and it cannot meet the different needs of the students since the classes in our schools consist of mixed ability groups (Ezeudu, 2011).Thus, the need to adopt technology based packages to improve the teaching and learning of biology for effective performance of students is urgently required. The use of technology has made the process of teaching and learning more enjoyable through Information, Communication and Technology (ICT) tools. Computer graphics and animation instructional modes are some of such innovative teaching methods that have been found effective in teaching some school subjects like Fine arts, Religious knowledge, drama and literature. One wonders if computer graphics and animation will also enhance interest, achievement and retention of secondary school students in biology. Graphics, according to Heller and Chwast (2011) are visual

images or designs on some surfaces such as a wall, canvas, screen, paper or stone to inform, illustrate or entertain. Computer graphics is the creation, storage and manipulation of drawing and picture with the aid of computer system (Adekoya & Adekoya, 2002). Animation is the use of cartoons and other graphic materials to create motion pictures. Computer animation is another presentation format that could be used to present biology concepts to secondary school students. Precisely computer animations are images in motion (Dwyer & Dwyer, 2003). It is the use of computer to create animation.

Purpose of the Study

The purpose of this study is to determine the effects of computer graphics and computer animation on students' interest, achievement and retention in genetics. Specifically, the study was designed to determine the:

- (1) difference in the mean interest rating scores of students taught genetics using computer graphics and those taught using conventional method.
- (2) difference in the mean interest rating scores of students taught genetics using computer animation and those taught using conventional method.
- (3) difference in the mean interest rating scores of students taught genetics using computer graphics and those taught using computer animation.

Research Questions

The following research questions were raised:

- (1) What is the difference in the mean interest rating scores of students taught genetics using computer graphics and those taught using conventional method?
- (2) What is the difference in the mean interest rating scores of students taught genetics using computer animation and those taught using conventional method?
- (3) What is the difference in the mean interest rating scores of students taught genetics using computer graphics and those taught using computer animation?

Hypotheses

The following null hypotheses tested at 0.05 level of significance guided the study:

- 1: There is no significant difference between the mean interest rating scores of students taught genetics using computer graphics and those taught using conventional method.
- 2: There is no significant difference between the mean interest rating scores of students taught genetics using computer animation and that of those taught using conventional methods.
- 3: There is no significant difference between the mean interest rating scores of students taught genetics using computer graphics and those taught using computer animations.

Research Design

The study adopted quasi-experimental design. Specifically, the study adopted a non-equivalent control group design.

Area of the Study

The area of this study is Aguata Education Zone of Anambra State. Aguata Education Zone consists of three Local Government Areas (L.G.A.s) namely: Aguata, Orumba South, and Orumba North. The people of the area are predominantly farmers and traders.

Population of the Study

The population of the study is all the Senior Secondary one (SS1) biology students in the 48 government owned secondary schools in Aguata Education Zone of Anambra State. The population size is 2,608SS1 students made up of 1,184males and 1,424 females.(Source: Aguata Education Zone Office)

Sample and Sampling Technique

The sample size comprised of 135SS1 biology students, 69 males and 66 females. A purposive and simple sampling techniques were used to draw three co-educational government owned senior secondary schools in Aguata Education Zone. A purposive sampling is one that is selected based on characteristics of a population and the purpose of the study.

Genetics Interest Scale (GIS) was used for data collection. The GIS is a 20- item interest scale drawn from 25- item initial pool developed by the researcher with a 4- point rating scale response options (see Appendix D page 102 for the initial pool. The students indicated their extent of agreement or disagreement on the 20 statements (10 positive and 10 negative) about the units of study in biology. Statements that are positively cued have values 4,3,2,1 while in those negatively cued, the weighting of

the response were reversed to ensure that higher scores always indicate more positive interest than lower scores i.e 1,2,3, and 4.

The GIS was validated by one specialist in science education from Nnamdi Azikiwe University Awka, one specialist in educational measurement and evaluation and one specialist in computer science from Federal College of Education (Technical), Umunze. As a guide to the validators for the validation exercise, research purpose, scope, research questions and hypotheses were given to them

Research Question I: What is the difference in the mean interest rating scores of students taught genetics using computer graphics and those taught using conventional method?

Table 1: Mean interest rating and standard deviation scores of students taught genetics using computer graphics and those taught using conventional method

Group	N	Pre- test		Post-test		Post-test Mean Gain
		Mean	SD	Mean	SD	
Computer Graphics	50	30.44	9.87	60.76	12.31	30.32
Conventional method	38	32.34	11.55	48.08	18.65	15.74

Mean difference between gps8.10 12.68 14.58

Table 1 reveals that students taught genetics using computer graphics had pre-test score of 30.44, posttest mean score of 60.76 and mean gain score of 30.32 while those in the conventional group had 32.34, 48.08 and 15.74 as pre-test mean score, post-test mean score and mean gain score respectively. The post standard deviation scores for computer graphics and conventional groups were 12.31 and 18.65 respectively. The mean gain score of students taught with graphics was greater than the mean gain score of those taught with conventional method. The difference between the pre-test mean rating scores, post-test mean interest rating scores and the mean gain scores of computer graphics group and conventional method group were 8.10, 12.68 and 14.58. This suggested that computer graphics instructional method was more effective in enhancing students' interest in genetics. Also the lower posttest SD in computer graphics group showed that students' scores clustered around the mean score than in conventional method.

Research Question II: What is the mean interest rating scores of students taught genetics using computer animation and those taught using conventional method?

Table 2: Mean interest rating scores and standard deviation scores of students taught genetics using computer animation and those taught using conventional method

Group	N	Pre-test Mean	Pre- test SD	Post-test Mean	Post-test SD	Mean Gain score Score
Computer Animation	47	39.72	12.68	78.62	10.75	38.90
Conventional method	38	32.34	11.55	48.08	18.65	15.74
Mean difference b/w groups			7.38	30.54		23.16

Table 2 reveals that the pre-test mean interest rating scores of students taught genetics using computer animation was 39.72 and post-test mean interest score was 78.62 while the mean gain score was 38.90. Their counterpart taught using conventional method on the other hand had 32.34 and 48.08 as pre-test post-test mean interest rating scores and 15.74 as mean gain score. The pre-test and post-test standard deviation scores for computer animation group were 12.68 and 10.75 respectively. The pre-test, post-test standard deviation scores for the conventional group were 11.55 and 18.65 respectively. The mean differences in the pre-test, post-test and mean gain scores for the computer animation group and conventional method group were 7.38, 30.54 and 23.16 respectively. Considering that, the mean gain score of students taught with computer animation was greater than the mean gain score of those taught with conventional method, it was concluded that computer animation instructional method was more effective in enhancing students' interest in genetics. The lower posttest SD in computer animation group showed that students' mean scores were clustered around the mean scores than in the conventional group. The high difference in the post-test mean interest rating scores and mean gain score was in the favour of computer animation group further showed that the interest of the students is better enhanced by using computer animation instructional mode than by using conventional method.

Research Question III: What is the difference in the mean interest scores of students taught genetics using computer graphics and those taught using conventional method?

Table 3: Mean interest rating scores and standard deviation scores of students taught genetics using computer graphics and those taught using computer animation

Group	N	Pre-test	Post-test	Mean Gain		
		Mean	SD	Mean	SD	
Computer Graphics	50	30.44	9.87	60.76	12.31	30.32
Computer Animation	47	39.72	12.68	78.62	10.75	38.90
Mean differences b/w groups			9.28	17.86		8.58

As displayed in Table 3, students taught genetics using computer graphics had 30.44, 9.87 and 30.76 as pretest, posttest and mean gain scores respectively while those taught using computer animation had 39.72, 12.68 and 38.90 as pre-test, post-test and mean gain scores respectively. The pre-test, post-test standard deviation scores for computer graphics were 9.87 and 12.31 respectively while the pre-test, post-test standard deviation scores were 12.68 and 10.75 respectively for computer animation group. The pre-test, post-test and mean gain differences between the two groups were 9.28, 17.86 and 8.58 respectively. The differences in the mean differences between the two groups and the higher mean gain score for students taught genetics with computer animation suggested that computer animation instructional mode was more effective in enhancing students' interest in genetics than computer graphics instructional mode. Also lower posttest SD in computer animation suggested that the students' scores were clustered around the mean score than in computer graphics. The post-test and mean gain differences between the two groups in favour of computer animation also proved that computer animation instructional mode enhances students' interest better than conventional method .

Hypotheses Testing

Hypothesis 1: There is no significant difference in the mean interest rating scores of students taught genetics using computer graphics and those taught using conventional method

Table 4: Summary of ANCOVA Test of Difference Between the Mean Interest Rating Scores of Students’ Taught Genetics Using Computer Graphics and Those Taught Using Conventional Method

Source	SS	DF	MS	F	P-value	Decision
Corrected Model	4875.514*	2	2437.757	10.973	.000	
Intercept	15950.715	1	15950.715	71.795	.000	
Pretest_Interest	1403.499	1	1403.499	6.317	.014	
Method	3848.469	1	3848.469	17.322	.000	*S
Error	18884.384	85	222.169			
Total	292717.000	88				
Corrected Total	23759.898	87				

*Significant *

In table 4 the analysis showed that there was a significant difference in mean rating interest scores of students taught genetics using computer graphics and those taught using conventional method, $F(1,85) = 17.322$, $P < 0.05$. Therefore, null hypothesis which posited no significant difference between the two groups was rejected.

Hypothesis 2: There is no significant difference in the mean interest rating scores of students taught genetics using computer animation and those taught using conventional method

Table 5: Summary of ANCOVA Test of Difference Between the Mean Interest Rating Scores of Students’ Taught Genetics Using Computer Animation and Those Taught Conventional Method

Source	SS	Df	MS	F	P-value	Decision
Corrected Model	20313.436*	2	10156.718	47.691	.000	
Intercept	25479.191	1	25479.191	119.638	.000	
Pretest_Interest	718.412	1	718.412	3.373	.070	
Method	15898.665	1	15898.665	74.652	.000	S
Error	17463.458	82	212.969			
Total	396512.000	85				
Corrected Total	37776.894	84				

Table 5 showed that there was a significant difference in mean interest rating scores of students taught genetics using computer animation and those taught using conventional method, $F(1,82) = 74.652$, $P < 0.05$. The null hypothesis of no significant difference between the two groups was therefore rejected.

Hypothesis 3: There is no significant difference in the mean interest rating scores of students taught genetics using computer graphics and those taught using computer animation

Table 6: Summary of ANCOVA Test of Difference Between the Mean Interest Rating Scores of Students' Taught Genetics Using Computer Graphics and Those Taught Using Computer Animation

Source of variation	SS	Df	MS	F	p-value	Decision
Corrected Model	7848.084 ^a	2	3924.042	29.253	.000	
Intercept	39267.597	1	39267.597	292.730	.000	
Pretest_Interest	122.806	1	122.806	.915	.341	
Method	5922.848	1	5922.848	44.153	.000	S
Error	12609.421	94	134.143			
Total	487811.000	97				
Corrected Total	20457.505	96				

^aSignificant

The data in table 6 showed that there was a significant difference in the mean rating interest scores of students taught genetics using computer graphics and those taught using computer animation, $F(1,94) = 44.153$, $P < 0.05$. The null hypothesis of no significant difference between the two groups was therefore rejected.

SUMMARY OF THE FINDINGS

The findings of the study from the research questions and hypotheses are summarized as follows:

1. There is a significant difference in the mean interest rating scores of students taught genetics using computer graphics and those taught using conventional method.
2. There is a significant difference in the mean interest rating scores of students taught genetics using computer animation and those taught using conventional method.
3. There is a significant difference in the mean interest rating scores of students taught genetics using computer graphics and those taught using animation.

DISCUSSION OF THE RESULTS

Effects of computer graphics and computer animation on Students' interest in genetics

The result from Table 1 showed that the mean gain interest rating scores of students in the computer graphics group was higher than the mean gain interest rating scores of students in the conventional group. This was further confirmed by the ANCOVA result in Table 10 which revealed that computer graphics was a significant factor on students' overall interest in genetics than conventional group. Thus it was confirmed that students in computer graphics had more interest in genetics than students in conventional group. This significant difference is attributed to computer graphics. This finding indicated that computer graphics instructional mode had a positive effect on students' interest in genetics.

This finding is in line with the findings of Sangodoyin (2011), Giganna (2013), Ali (2012) and Furo (2015) who also discovered that CAI enhanced students' interest. This result was attributed to the fact that students have more interest when the instructional mode appeal to more than one of their senses. Thus, the use of visual representation of object (visual aids) which appeal to the students' sense of sight and performance of practicals with the computer which appeal to their sense of hearing go a long way to enhance their interest in learning. These senses of sight and touch according to the Behaviourist theory (S-R theory) are the stimuli which could be visual event, a sound, a taste, a touch a smell or any combination of these while a response is the reaction to a stimulus in this study it led to the enhancement of students' interest.

The result in Table 2 indicated that the overall gained mean interest rating scores of students taught genetics using computer animation was greater than those taught using conventional method. This was further confirmed by the ANCOVA result in Table 5 which revealed that computer animation had a significant effect on students' interest in genetics. This significant difference is attributed to the treatment. This implies that computer animation instructional mode had positive influence on students' interest towards genetics than conventional method. This findings showed that computer animation instructional mode had positive effect on students' interest. This result was attributed to the fact that students' interest increases when taught using computer animation instructional mode. This is in line with the studies of Furo (2015); Hussan & Ali (2012) who found that the adoption of CAI

instructional mode enhanced the interest of the students. As displayed in Table 3 the mean gain of students taught genetics using computer animation was higher than those taught using computer graphics. Significant effect between computer graphics and computer animation instructional modes on students' interest in genetics was also detected in favour of computer animation as shown in Table 6. Computer graphics and computer animation were both effective in enhancing students' interest however, computer animation was more effective in enhancing students' interest than computer graphics. The findings support that of Ariffin et al who found out that the use of computer animation helped students apply the information provided than the use of computer graphics.

CONCLUSION

On the basis of the findings, the instructional modes adopted by the teachers greatly affect the students' learning of the concepts. This is usually reflected in their interest of learning. Computer graphics and animation instructional modes enhanced students' interest in genetics when used together with conventional method.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations have been proffered:

1. Teachers, especially those teaching biology should always adopt the computer graphics and animation instructional modes that will captivate their interest, improve their in genetics.
2. Teacher education programmes should include computer graphics and animation instructional modes in biology method course content. This will ensure that the biology teachers are adequately trained on how to use computer graphics and animation instructional modes in the teaching and learning of genetics
3. Ministries of Education, both state and Federal should organize workshops and seminars and sponsor teachers to attend in service courses on how to use computer graphics and animation instructional modes to improve their teaching skills which are found by this study to be effective in promoting students' interest.
4. Students should be encouraged to be serious to embrace this activity - oriented and student- centred approach which will enable them carry out independent or group work, such as assignment and project given to them by the biology teachers and also make their instructions

authentic by relating what they have learnt to their personal experiences or real world situation.

5. From the findings of this study, it is recommended that examination bodies should be able to develop appropriate assessment instruments that will enable them to assess students' performance or abilities using CAI (computer graphics and animation).

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