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## **The use of Multimedia in Teaching Biology and Its Impact on Students' Learning Outcomes**

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**Abstract:** In this 21st century of Information and Communication Technology, a motivating and captivating approach should be encouraged to help students better learn. The use of multimedia in education has proven its importance due to its positive impact on the teaching and learning process. The study investigated the effectiveness of using Multimedia on students learning outcomes in biology. 180 students were randomly selected from three secondary schools and were randomly divided into three groups. Pretest-posttest control group quasi experimental design was employed for the study. The experimental groups was taught with the help of multimedia presentations whereas the control group was treated traditionally. The treatment was given for a period of 10 weeks. Validated Attitude Towards Biology Scale (ATBS) was tested for reliability using Crombach alpha which stood at 0.76 and Biology Achievement Test (BAT) which was also validated was tested for reliability using Kuder Richardson (KR,20), yielded 0.89, were used as data collection instruments. The data collected were analysed using descriptive and inferential statistics. The results indicated a statistically significant difference between students learning outcomes and modes of instruction. Students under Multimedia Aided Instructions had better outcome than their colleagues in traditional teaching method. Therefore, it is recommended that Multimedia Assisted Instruction should be used in the teaching of biology at secondary school to improve students' learning outcomes in the subject.

**Keywords:** Multimedia, Biology, Students, Learning outcomes, Secondary school

### **Introduction**

Biology is a science subject which explains the existence of life. It is a natural science which is concerned with the study of living organisms, their structures, forms and functions, heredity, etc. It is a fundamental science subject which serves as the basis for understanding the complexities of how the body parts of organisms function. Biology according to Taiwo & Emeke (2014) the subject exposes the students to the world of knowledge of self, the immediate and distant environment. This may be the bases for its inclusion in the Senior Secondary School (SSS) curriculum in Nigeria. The objectives of teaching Biology in the SSS in Nigeria include 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 (FME, 2009).

Despite the importance of the teaching of Biology in SSS in the development of individuals, several studies (WAEC, 2011; Taiwo & Emeke, 2014) report consistent poor performance of students at the internal and external examinations. According to WAEC Chief Examiners' report (WAEC, 2014), there has been a downward trend in students achievement in biology over the years. The results show that for the over one million students per year that registered for Biology, only 35.74%, 35.61%, 33.57%, 33.94% and 33.87% passed at A-C6 level for 2010, 2011, 2012, 2013 and 2014 respectively.

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Many factors have been adduced to this poor performance of students in biology achievement. Such factors include teacher quality (Akinsolu, 2010; Anita, 2013), school factors (Mushtaq & Khan, 2016), types of textbooks (MeenuDev, 2016), teaching methodology (Owusu, Monney, Appiah, & Wilmot, 2010), etc. However, the reports have showed that the major cause of poor performance of students to science subjects to be the prevailing method of teaching in science classroom in Nigeria (Ukoh & Adewale, 2014).

In order to achieve the laudable objectives of teaching and learning biology in Senior Secondary School, the teaching of biology should be well strategized to bring about meaningful learning which could improve students' performance. Teaching for understanding and to bring about meaningful learning in Biology may involve the use of appropriate method. Considering UNESCO (2002) recommendation on improving the teaching of science – diversification of contents and methods, promoting experimentation, innovation, the diffusion and sharing of information, this could also be applied in the teaching of biology. The diversification of contents and methods, innovations could be utilized through integration of technology in biology teaching. One important factor that has separated the modern era from those that have gone before it is technology.

Since the current teaching strategies commonly used for teaching science have failed to enhance problem-solving skills, curiosity and critical and logical thinking among the science students (Shan & Khan, 2015), there is a great demand to shift to technology integration strategies as a new form of pedagogy. Most especially paradigm shift of integration of Information and Communication Technology (ICT) since teaching principally involves passage of information through communication.

Information and Communication Technology (ICT) is not something new nowadays. Somehow, ICT appears to be a force which has changed lots of aspects in life. We are all living in the decade of Information and Communication world. ICT is more innovative and could enrich approaches for meaningful learning. The communication technology comprises of all forms of technology to create, store, exchange information (such as business data, video, audio, still images, text, pictures, etc) with high – speed communication links carrying data, sound and video. When more than one of these are utilized in communication process, it is regarded to as Multimedia.

Therefore, multimedia is described as a system of relaying information that involves many different forms of communication. Multimedia might include text, video, audio, still photographs, sound, animation, image and interactive content. It is any combination of the above mentioned that is delivered by computer. Malik & Agarwal (2012) refers to multimedia as the exciting combination of computer hardware and software that allows integration of text resources, audio, animation, graphics, video to develop effective presentation on an affordable desktop computer. Buttressing this view, Neo (2007) says multimedia is characterized by the presence of texts, pictures, sound, animation and video; some or all of which are organized into a coherent program. From the definitions, it could be deduced that multimedia involves communication or presentation of information through multiple channels. Some or all of these elements (i.e sound, animation, text, audio, image, graphic, video, etc) could be combined and used in biology classroom for teaching process.

The multisensory nature of multimedia makes it to stimulate multiple senses of the audience at a time. If applied in biology classroom, it could stimulate students' senses in the classroom and allow interaction between the students and teachers. These could make teaching biology more attractive and interesting to students and as well enhance students' motivation and understanding thereby making learning meaningful and authentic. This is supported by Altherr, Wagner, Ecker & Jold, (2004) and Sousa, Richter & Nel (2017) assertion that multimedia elements have paramount importance in teaching of science since it helps to present different phenomenon and process vividly, simulate complex contents and present different levels of abstraction. Thus, some concepts which appeared abstract to students may become clearer and better retained. This may have positive effects on students' academic achievement and attitude to learning of the subject. However, with the level of technological development and integration in education globally, the use of multimedia in teaching biology in secondary school in Nigeria has not been successive.

When student's interest increases, understanding becomes enhanced and retention ability increased (Gilakjani, 2012), there is tendency for an improvement in academic achievement and attitude. This is in accordance with Mantei (2000) remark that power point presentation in teaching science improves student's attitude towards science.

Attitude is a learned disposition to respond positively or negatively towards a situation, an event or people (Shah and Khan, 2015). It is a disposition to evaluate situations, actions or people in a favourable or unfavourable way. Student's attitude towards a subject is often developed as a result of experiences in different learning environment. Therefore, attitude is very important in student's achievement in a subject. Shah, Iqbal & Rauf, 2010; Soomro, Qaisrani & Uqaih, (2011); Shah & Khan, (2015) in separate reports remark that student's attitude towards learning of science subjects has impact on the academic achievement

The attitude of students towards science subjects may or may not vary with gender. There are mixed reports on existence of differences in male and female students' attitudes towards biology. While some scholars are of the view that student's attitudes toward biology are not affected by gender (Ahmad & Asghar, 2015), others disagree with this submission (Usak, Prokop, Tuncer & Chuda, 2009).

Therefore, this study investigated the impact of the use of multimedia in teaching biology on students' learning outcomes.

### **Purpose of the Study**

The purpose of this study is to investigate whether the use of multimedia to teach could improve secondary school students' learning outcomes (students' achievement and attitude) in biology. Specifically, the study examined the effect of:

- i. On screen text, graphics, still images packages and teachers' explanation and those exposed to conventional teaching as posttest.
- ii. On screen text, graphic, still images, video packages and teacher' explanation and those exposed to conventional teaching as posttest
- iii. Conventional method

### **Research Questions**

The following questions were answered in the study

1. Does any difference exist in the learning outcomes of the groups of students before exposure to treatment?
2. Does any difference exist in the learning outcomes of the groups of students after exposure to treatment?

### **Hypotheses**

The following null hypotheses were tested at 0.05 level of significance.

1. There is no relative effect of treatment on students' learning outcomes
2. There is no relative effect of gender on students' learning outcomes
3. There is no interaction effect of treatment and gender on students' learning outcomes.

### **Method and Procedure**

The study employed a pretest-posttest control group quasi experimental design.

### **Population**

The population for this study is made up of all Senior Secondary School Two (SSS II) biology students in Lagos Mainland Local Government Area, Lagos State, Nigeria.

## **Sample and Sampling Technique**

Senior Secondary School (SSS) in Lagos Mainland with adequate Information and Communication Technology facilities were purposely selected for the study. Out of the four found with ICT materials, three Senior Secondary Schools were randomly selected from Lagos Mainland Local Government Area, Lagos, Nigeria. A sample of sixty students was randomly selected from each of the three schools. In all one hundred and eighty students participated in the study.

## **Instrumentation**

Two instruments were developed and used to collect data for the study:

- (a) Biology Achievement Test (BAT)
- (b) Biology Students' Attitude Questionnaire (BSAQ).

The BAT was made up of 50 objective questions prepared from past West African Senior Secondary School Certificate Examination questions of West African Examinations Council on the selected topic – Regulation of Internal Environment. The items were developed on the basis of Bloom's taxonomy with the distribution. This was peer reviewed for content and construct validity. The reliability was tested by administration of the test to thirty SSS II students who are not part of the study. The reliability stood at 0.78 using Kuder Richardson 20 (KR 20). The BSAQ was made up of twenty – five questions on SSS II students' attitude. Validation exercise was conducted with the instrument on thirty students who are not part of the study. The reliability coefficient was 0.81 using Cronbach Alpha.

## **Procedure for the Study**

Three schools were randomly selected from Lagos Mainland Local Government Area, Lagos, Nigeria. Sixty Senior Secondary School Two (SS II) students were randomly selected from each of the three schools. Thereafter, the participants were mixed, reshuffled and redistributed into three groups. Each group consisted of sixty participants. The groups were randomly assigned into two experimental and one control. Experimental group one was taught on-screen text, still images and graphic packages and teachers' narration; experimental group two was taught on screen text, still images, graphics, video and teachers' narration while the third group was the control and were taught using lecture method. In order to establish a baseline and ascertain the academic equivalence of the students before the treatments, the Biology Achievement Test was administered to the selected students. This serves as the pretest for the study. Four research assistants were employed and gave necessary orientation and training of the tasks involved in the use of the multimedia in teaching biology and the administration of the instruments. The research assistants were randomly assigned into groups and trained based on the group they were to handle. Three of the research assistants who taught the three groups were graduates in biology education. While the fourth only assisted in the collection of data.

The on-screen text, still images and graphic packages for experimental group one consisted of concepts of regulation of internal environment; while experimental group two consisted of on-screen text, still images, graphic and video packages with concepts on regulation of internal environment. The two packages were developed by the researcher but validated by specialists in biology education and educational technology.

Two lecturers each from Biology Education and two lecturers from Educational Technology, of the Department of Science and Technology Education, University of Lagos, Nigeria; two biology teachers from Senior Secondary Schools in Lagos; and two subject experts in the Test and Measurement Department, West African Examination Council (WAEC) Nigeria, all validated the content of biology, appropriateness of packages and the achievement test. The two packages were tested on some selected SS II students outside the sampled schools. The comments and observations from valuers and students were used to modify the instruments packages. The biology content for experimental groups were produced on a CD-ROM and installed in the system, while the control group used the same content, but was not exposed to multimedia packages.

The researcher visited the selected schools and sought the cooperation of their staff and students. The treatment was administered for four weeks. The multimedia packages were projected onto the screen via a projector. Students read,

listened, and watched on the mode of multimedia approaches to teaching in the two experimental groups. Experimental Group I: On screen text, still images, graphics package and teachers' explanation. Sixty students in this group watched the on screen text, still images and graphics depicting explanation of regulation of internal environment. The students also listened as the teacher explained slide by slide concurrently.

Experimental Group II: On screen text, graphic, still images, video and teacher's explanation. The students in this group, who were also sixty, watched the on screen text, still images, graphics and video which depicted concepts of regulation of internal environment. The teacher also explain concurrently

Control Group: Conventional Teaching Method: The control group was exposed to lecture method.

Immediately after four weeks of treatment, BAT and BSAQ were administered as posttest to measure the students' learning outcomes (academic achievement and attitude) of different groups.

Data collected were analysed based on the formulated hypotheses and research questions. Analysis of Covariance (ANCOVA) and Scheffe's post-hoc analysis was employed.

## Results and Findings

The result of the study was presented according to the research questions asked and hypotheses raised.

**RQ1:** Does any difference exist in the learning outcomes of the groups of students before exposure to treatment?

Table 1. Students' performance at before treatment

Comprehension Levels	Mean	SD	Rank
Conventional	20.13	4.74	2 <sup>nd</sup>
With Video	21.20	6.41	1 <sup>st</sup>
Without Video	19.00	5.51	3 <sup>rd</sup>

Table 1 above reveals the highest mean performance (21.20) of students taught with video, followed by 20.13 average mean performances for the students taught with conventional method, and the least mean performance (19.00) for the students taught without video.

**RQ 2:** Does any difference exist in the learning outcomes of the groups of students after exposure to treatment?

Table 2. Students' performance after treatment

Comprehension Levels	Mean	SD	Rank
Conventional	20.64	5.14	3 <sup>rd</sup>
With Video	23.38	6.24	1 <sup>st</sup>
Without Video	22.31	5.83	2 <sup>nd</sup>

Table 2 above reveals the highest mean performance (23.38) of students taught with video, followed by 22.31 average mean performances for the students taught without video, and the least mean performance (20.64) for the students taught with conventional method.

**Ho1:** There is no relative effect of treatment on students' learning outcomes

Table 3. Effect of treatment on students' learning outcomes

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	185.506 <sup>a</sup>	3	61.835	1.851	.141
Intercept	2270.268	1	2270.268	67.963	.000
Pretest	1.005	1	1.005	.030	.863
Group	180.773	2	90.386	2.706	.070
Error	4576.381	137	33.404		
Total	74911.000	141			
Corrected Total	4761.887	140			

a. R Squared = .039 (Adjusted R Squared = .018)

The table 3 above revealed an F (2, 140) 2.706 was not significant with a value of .07 at 0.05 alpha level. On this basis, the null hypothesis one was accepted since the significant value .07 is greater than 0.05 alpha level (.141 > 0.05). Thus, no significant main effect of treatment on students' learning outcomes existed between the three groups (Experimental I, Experimental II and Control).

**Ho2:** There is no relative effect of treatment on students' learning outcomes based on gender

Table 4. Effects of treatment on students' learning outcome according to gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	170.476 <sup>a</sup>	2	85.238	2.275	.111
Intercept	494.592	1	494.592	13.201	.001
Pretest	93.742	1	93.742	2.502	.119
Gender	158.815	1	158.815	4.239	.044
Error	2322.909	62	37.466		
Total	38038.000	65			
Corrected Total	2493.385	64			

a. R Squared = .068 (Adjusted R Squared = .038)

The table revealed an F (1, 64) 4.24 with a significance value of .04 at 0.05 alpha level. On this basis, the null hypothesis one is rejected since the significant value .04 is less than 0.05 alpha level (.04 < 0.05). Thus, gender had significant effect on students' learning outcomes when exposed to treatment. A follow-up of the posttest mean score test was conducted to locate where the significant difference existed using pairwise comparisons. The mean scores of the two groups are indicated in Table 5.

Table 5. Differences in the effects of treatment on gender

Gender	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Female	21.498 <sup>a</sup>	1.190	19.120	23.877
Male	25.214 <sup>a</sup>	1.169	22.878	27.550

Table 6. Differences in means of gender based on treatment groups

(I) gender	(J) gender	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>	95% Confidence Interval for Difference <sup>b</sup>	
					Lower Bound	Upper Bound
Female	Male	-3.716*	1.805	.044	-7.323	-.108
Male	Female	3.716*	1.805	.044	.108	7.323

Based on estimated marginal means

\*. The mean difference is significant at the .05 level.

The data in the table indicates that there was a difference in the posttest mean of male and female students exposed to treatment with the highest mean of (25.21) for male and the mean of (21.48) for female. Thus, male performed better than female.

**Ho3:** There is no interaction effect of treatment and gender on students’ learning outcomes

Table 7. Interaction effect of treatment and gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	288.360 <sup>a</sup>	5	57.672	1.740	.130
Intercept	1543.506	1	1543.506	46.579	.000
Pretest	26.857	1	26.857	.810	.370
Gender	43.185	1	43.185	1.303	.256
Group	73.511	2	36.756	1.109	.333
gender * group	21.909	1	21.909	.661	.418
Error	4473.527	135	33.137		
Total	74911.000	141			
Corrected Total	4761.887	140			

a. R Squared = .061 (Adjusted R Squared = .026)

Table 7 above revealed an  $F_{(1,140)}$  with a significant value of .418 at 0.05 alpha level. On this basis, the null hypothesis is accepted since the significant value is greater than 0.05 alpha level (.418>0.05). Thus, no interaction effect of treatment and gender.

**Ho4:** There is no relative difference in male and female students’ attitude to the use of multimedia in learning biology

Table 8. Differences in male and female students’ attitudes to use of multimedia

Gender	No	$\bar{X}$	SD	df	T	Sig
Male	62	24.7	14.82			
					5.38	0.00
				139		
Female	79	25.3	9.67			

Table 8 indicates that  $t(139) = 0.00, p = 5.38$  That is, the result of the t- value of 5.38 resulting in 0.00 significance value was lesser than 0.05 alpha level. This means that the stated null hypothesis was rejected.

## Discussion

The result of the study revealed an existing difference in the learning outcomes of students before and after exposure to treatment. There was students’ improvement in the achievement and attitude to biology. This shows that the use of multimedia in the teaching of biology made the difference. The uses of multimedia in the teaching of biology are accountable for the improved differences in the learning outcomes. The conventional group did not show any improvement in the students’ learning outcomes. The multimedia used for teaching in the two treatment groups must have catch students’ attention and interest, thereby improving the learning outcomes. This is in support of Aloraini (2012) submission that the uses of multimedia to teach has positive effects on students’ learning outcomes while the conventional strategy of teaching does not have an improvement on students’ learning outcomes. However, the differences or effect of the multimedia observed on the students’ learning outcomes was not significant. This may be due to insufficient skill on the part of the teachers. Many biology teachers have not acquired enough necessary skills needed to use multimedia in teaching biology. This may be due to the fact that the multimedia is not yet part of biology classroom. This implies that the chalkboard and textbook dominate biology classroom activities. This is in accordance with Aduwa-Ogiegbaen & Iyamu (2005) remark that more than 90% of Nigerian public schools still make use of chalkboard and textbook.

The study further revealed that gender has significant effect on students' learning outcomes. The male students have better learning outcomes as compared to the female students. This may be the source of increase or effect of multimedia on students' learning outcomes.

On the combined effect of multimedia and gender, on students' learning outcomes, the result revealed that these have no effect on students learning outcomes. This is in line with Erinoso (2008) and Ebo (2016) submission. But, this finding is contrary to the findings of Arigbabu & Mji, (2004) and Bosede, (2010) that students' academic achievement in science and technology subjects in computer mediated instruction is influenced by gender with male students outperformed the female counterparts.

## Conclusion

The adoption and use of multimedia in teaching biology have a positive impact on students' learning outcomes in biology. The lessons presented by multimedia are more effective and better comprehended by students. It is more effective for the cognitive and attitude development of students in biology than the conventional method. Multimedia use in teaching is more attractive and helps students develop positive attitude towards learning biology, thus improving the performance of students.

## Recommendation

Based on the findings of this study, it is therefore recommended that multimedia should be used to teach biology in Senior Secondary Schools. To this end, biology teachers need to be trained to acquire necessary skills needed to use multimedia for teaching biology. This is important in preparing teachers for biology teaching, as well as providing in-service training for biology teachers.

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