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## THE EFFECT OF MULTIMEDIA INSTRUCTIONAL PACKAGES ON STUDENTS' ACADEMIC ACHIEVEMENT IN BIOLOGY

*Research Article*

Bukola O. Akinbadewa 

Obafemi Awolowo University, Nigeria

[bukolaakinbadewa@yahoo.com](mailto:bukolaakinbadewa@yahoo.com)

Bukola O. Akinbadewa is a researcher at the Department of Educational Technology and Library Studies, Faculty of Education, Obafemi Awolowo University, Ile-Ife, Nigeria. She has also been a teacher of Biology at Secondary Schools level in Nigeria since 2016.

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Bukola O. Akinbadewa

[bukolaakinbadewa@yahoo.com](mailto:bukolaakinbadewa@yahoo.com)

## Abstract

This study examined the effects of computer-based multimedia instructional packages on the academic achievement of students offering Biology in Senior Secondary Schools in Ibadan, Oyo State, Nigeria. Two multimedia instructional packages were designed for the study. The study adopted the pretest-posttest, control group, experimental research design. The population of the study consists of 80 randomly selected students from three secondary schools in Ibadan, Oyo State, Nigeria. The samples were randomly assigned to three groups (one control and two experimental groups). The moderating effects of gender and learning styles were also tested. The results showed that there was a significant main effect of treatment on students' achievement in Biology ( $F(2, 58) = 27.18$ ;  $P < 0.05$ ; partial eta square = 0.48). Also, gender had no significant main effect on students' performance ( $F(1, 58) = 3.97$ ;  $P > 0.05$ ; Partial eta square = 0.06). It was therefore concluded that multimedia instructional packages significantly enhanced students learning of Biology concepts than the conventional strategy, regardless of gender and the preferred learning style of students. Therefore, it was recommended that more multimedia instructional packages be designed and used in secondary schools for effective and efficient teaching and learning of Biology.

*Keywords:* multimedia instructional packages, academic achievement, Biology, teaching strategy, learning styles, gender

## 1. Introduction

Teaching Science, Technology, Engineering and Mathematics related contents have been challenging to many educators. Traditional teaching methods are dominating science classrooms and these methods have incessantly posed challenges to both the learners and the teachers over the years. Biology is an integral part of science and is one of the core foundational science subjects' students are exposed to prepare them for future scientific explorations and endeavours (Amons & Bassey, 2017). Biology has been a very important subject in the field of science and has been linked to most human activities including those of food, water, health, ecosystem management, agriculture and conservation, amongst several others. Biology literacy has, therefore, become relevant for everyone all over the world because of the awareness it brings.

Biology is one of the core subjects in Nigeria secondary school curriculum and is the branch of science that provides students with adequate and relevant skills for problem-solving, critical thinking, communication, and objective reasoning, all of which are 21st-century skills that will make them relevant in the future place of work (Oghenevwede, 2019), and teachers, who are the curriculum implementers are saddled with the responsibility of ensuring that the objectives of the subject are achieved.

However, over the years, the performance of students in the subject has been appalling. Biology education seems to be failing as many students perceive Biology to be boring. This

poor perception is attributed to the high level of abstraction and invisibility of phenomenon and processes of Biology concepts (Agboghroma & Oyovwi, 2015; Ahmed & Abimbola, 2011; Cimer, 2012; Etobro & Fabinu, 2017). This problem has been identified by researchers as instrumental to the poor performance of students in the subject, thereby making it difficult to achieve the objectives as stipulated in the National Policy of Education (FME, 2009), and making it increasingly difficult for Nigeria to achieve her vision of becoming one of the 20 most developed countries in the world by the year 2020 (Inegbenebor, Socilis, Nduka, Salawu, & Onyisi, 2018).

Differences has been noticed in the academic performance of students in secondary schools, and these differences have been attributed to a multiple variables involved in the learning process. Two of such variables mentioned in literature are gender (Abdu Raheem, 2012; Adigun, Onihunwa, Irunkhai, Sada & Adesina, 2015; Heo & Toomey, 2020; Otutola, 2017) and learning style (Huang, Luo, Yang, Lu & Chen, 2019; Moussa-Inaty, Atalanta & Causapin, 2019; Surjono, 2015). Studies reveal that there have been stereotypes in issues that relate to gender and learning style of students. For example, Art and languages have been stereotyped over the years as the domain for females while Mathematics, Science and Social Sciences has been stereotyped as that of males. To get rid of this stereotypes and ensure equal academic achievement for both males and females in subjects, Abdu Raheem (2012) suggested that necessary materials/equipment that would make learning interesting and enjoyable be made available to students, and Yukiko (2016) opined that for multimedia instruction to meet both students and teachers' needs, then, instruction should shift from passive, teacher-centred classroom to active student-centred one.

Hence, modern instructors suggested that constructivist and interactive instructional approaches be utilized in classrooms (Pirker & Gütl, 2015). Thus, teachers should not just teach how to recite, but teach how to solve problems and apply the taught methods. To achieve this, Etobro and Fabinu (2017) suggested making subject content of senior secondary school biology curriculum more contemporary, meaningful, and interesting for students. Thus, visualization of concept and processes to better improve students' understanding, through an instructional strategy supported by computer-based multimedia instructions is being suggested.

The term multimedia has been defined in different contexts, depending on the multimedia element used. For example, Mayer (2000), defined Multimedia as the presentation of learning media using both preferential and verbal forms such as spoken and printed texts. Khasawneh (2009) defined multimedia as the "design, implementation, manipulation, storing, and proper delivery of various types of media to interested users" (p. 1). Mukherjee (2018) opined that multimedia should be interactive, it should be controllable by the user.

Worldwide, multimedia is affecting the educational landscape and has been labelled as a tool that can enhance effective and efficient teaching and learning. However, while it is increasingly used in many developed countries in computer-based narrated animations, observations have shown that the use of computer in developing countries such as Nigeria to teach secondary school students is still a thing of novelty. Though studies have shown the importance of computer technologies in education, the place of implementation has posed serious challenges, and appalling performance of students in many subjects, and particularly in the sciences, has been the consequence. Hence, this study considered a change from the conventional method of teaching to a computer-based one, intending to find out the effect of computer-based multimedia instructional packages on students' academic achievement in Biology.

### 1.1. Literature Review

The study is guided by the Cognitive Theory of Multimedia Learning (CTML) designed by Richard E. Mayer in the 1990s. CTML is a cognition model that attempts to build a meaningful connection between words and pictures. The theory explains that students learn more deeply with a combination of words and pictures than with either words or pictures alone. Based on the theory, multimedia brings about meaningful learning, and meaningful learning can only be said to have been achieved if the learner can apply the knowledge of what he/she has learned in new situations. Principles such as multimedia principles, coherence, personalization, and pre-training principles, amongst others, that add more thought specifically to the construction of presentations are found in the theory (Moreno & Mayer, 2000). These principles are applied in the design of the multimedia instructional packages used in this study.

With the evolution of multimedia in education, learning has gradually moved from the era of the teacher being the repertoire of knowledge or the students being the passive recipients. Now, the role of both teachers and students' have significantly changed. Teachers are now facilitators of learning and students are active participants in the learning process (Oshinaike & Adekunmisi, 2012). Adegoke (2010, 2011) found that learners retain more when a variety of senses are engaged in learning; and that the experience allows them to retain and recall information. Son & Simonian (2016) opined that supplementing traditional teaching classroom with multimedia learning tools could enhance students' motivation to learn, and make them active in the learning process, thereby, improving practice. Likewise, several similar studies have reported the increased academic success of students where multimedia techniques are applied, and this success is attributed to the ability of multimedia technology to capture students interest and get them engaged in the course of learning (Ilhan, & Oruç, 2016; Park et al., 2019; Son & Simonian, 2016). This implies that the mental representation and connections of learning materials in words and pictures enhance students' engagement via active learning (Park et al., 2019). Hence, multimedia, in its many formats, has been found to play a crucial role in education indeed. However, care must be taken when designing multimedia instructions so as not to overload the working memory (Moussa-Inaty et al., 2019).

Also, some studies have shown that learners' cognitive/learning style influences their academic performance. This implies that each individual has a specific way of grasping a particular concept or situation. This specific way of understanding concept or situations is called Learning Style. James and Gardner (1995) defined learning style as the "complex manner in which, and conditions under which, learners most effectively perceive, process, store, and recall what they are attempting to learn" (cited in Hawkar, 2014, p. 241). Several researchers have investigated the effect of learning style on the academic achievement of students. While some studies found a significant effect of learning style on academic achievement, some did not. For example, studies of Bethel-Eke and Eremie (2019) and Magulod (2019) showed learning styles to impact significantly on learning. However, some studies have debunked the notion that learning style has any significant effect on academic performance. For example, Munir, Ahmad, Hussain, and Ghani (2018); and, Huang, et, al. (2019) do not find any significant relationship between learning style and students' academic performance. Also, while some researchers suggest that learning style issues should be taken into consideration when trying to understand how learners learn more effectively (Kirshner, 2017; Knoll et al., 2016), some other researchers believe that instructional designers do not need to necessarily take students preferred learning style into account to facilitate learning, but rather focus on consideration of mental constraints (Moussa-Inaty et al., 2019). Hence, learning style may be an important variable to also consider and experiment in this study.

Gender inequality, particularly in developing countries is not a new phenomenon. It has been a topic that has drawn the concerns of NGOs, stakeholders, educators, amongst others, which has prompted the cry for equality in education for the girl child. United Nations (UN, 2013) opined that achieving gender equality in education means an equal opportunity for both males and females to have equal learning process, equal learning outcome, as well as equality in external results after leaving school. The issue of gender and academic achievement has for a long time remained a controversial one. For instance, while some studies found a significant effect of gender on students' academic achievement (Heo & Toomey, 2020; Otutola, 2017), some did not (Akinoso, 2018; Abidoye, 2015; Adigun et al., 2015; Nnamidi & Oyibe, 2016; Powell, 2004). Some researchers, therefore, concluded that male and female students would perform equally the same if they are exposed to the same type of instructions (Huang et al., 2019; Moussa-Inaty et al., 2019). Therefore, as Calsmith (2007) opined, the influence of gender and differences in academic performance is a complex task, making many studies appear to be contradictory. Hence, while Gender has been linked with the performance of students in several studies, but with no definite conclusion, this study aims to add to the body of literature in the area, and also find out if multimedia instructional packages could help enhance gender equality in the academic achievement of students in Biology.

## **1.2. Statement of the Problem**

Although the benefits of multimedia presentations are well known, they are not too widely used in Nigeria secondary schools. In most schools, the traditional method of teaching in which the teacher is the repertoire of knowledge is still the order of the day, and this method is used to teach even science subjects such as Biology which naturally, is full of abstract concepts and phenomenon. As a result, many students fail the subject at both internal and external examinations level, leading many to lose interest in the subject, believing it is too complex to understand. Several studies have identified the traditional teaching strategy as contributory to this problem. Therefore, there is a need to explore a change in teaching strategy, hence, this study.

## **1.3. Purpose of the Study**

This study aims to investigate the effects of multimedia instructional packages on students' academic achievement in Biology, and also examine the effects of gender and learning style on students' academic achievement.

## **1.4. Research Questions and Hypotheses**

One research question and four hypotheses are investigated in this study.

### **1.4.1. Research question**

R.Q 1: What is the level of students' achievement in Biology when exposed to the treatments?

### **1.4.2. Research hypothesis**

The following null hypotheses are generated and tested at 0.05 level of significance:

H<sub>01</sub>: There is no significant main effect of treatment on students' academic achievement in Biology.

H<sub>02</sub>: There is no significant main effect of gender on students' academic achievement in Biology.

H<sub>03</sub>: There is no significant main effect of learning styles on students' academic performance.

H<sub>04</sub>: There is no significant interaction effect of treatment, gender and learning styles on students' academic achievement in Biology.

## **2. Methodology**

### **2.1. Research Design**

This study adopts the pre-test, posttest control group experimental design. Simple Random sampling technique was used to select the 80 students that participated in the study. Biology content pre-test was used as a covariate. The design is structured as follows

Experimental Group 1: A1 + Q1 + A2

Experimental Group 2: A1 + Q2 + A2

Control Group: A1 + Q3 + A2

Where

A1 = Pre-test Assessment for experimental and control groups (covariate)

Q1= Treatment: multimedia instructional package 1

Q2 = Treatment: multimedia instructional package 2

Q3 = Conventional (chalk and talk) teaching method

A2 = Post-test assessment for experimental and control groups

Two multimedia instructional packages were designed for the study. The first, MIP 1 was designed with pictures, narrations and onscreen texts. The second, MIP 2 was designed with animations, narrations, onscreen texts and video clips. Topics on cell division: mitosis and meiosis were divided into the duration of six weeks in each package. The packages were validated by two Educational technologists, one test and measurement expert and two Biology teachers.

The experimental group 1 was exposed to MIP I and experimental group II was exposed to MIP II. A user guide was given to the students in the experimental groups ahead of the study to prepare them for the study. The control group was exposed to the conventional "talk and chalk" method. The learning styles of the students were determined through the VAK Learning Style Indicators, adopted from Sanni, K. T. (2014). The teachers in the experimental groups were facilitators, clarifying concepts, answering questions and initiating feedback from students.

### **2.2. Study Participants**

The population for the study consists all students offering Biology as a subject in the senior secondary schools in Ibadan North Local Government Area, Oyo State, Nigeria, from where a sample of 80 students was randomly selected from three secondary schools. The samples were also randomly assigned to three groups (one control and two experimental groups). Table 1 shows the grouping of the participants.



Table 1. *Grouping*

Gender	Control group	Exp. group 1	Exp. group 2
Female	17	13	6
Male	23	8	13
Total	40	21	19

### 2.3. Research Instrument

The two instruments used in the study are the Biology Achievement Test and the VAK Learning Style Indicators.

The Biology Achievement Test (BAT) consists of 30 multiple-choice questions on Cell Division with four possible answers for each question (A-D). The items were extracted from past questions between the years 2005 and 2015 from West Africa Examination Council (WAEC), a standardized examinations body in West Africa. To ensure further validity of the instrument for the set of students in the study, the face and content validity of the instrument was done. Two Biology teachers, two educational technologists and one expert of test and measurement participated in the validation of the instrument. The BAT was also trial tested on 20 students from two schools not participating in the research to test for its reliability. From the analysis of the students' responses, a reliability coefficient of 0.72 was established using the Kuder-Richardson (KR 20) formula. This implies the instrument was reliable. The BAT was used as the pre-test as well as the post-test.

VAK Learning Style Indicators: VAK Learning Style Indicators (VLSI) was adopted from Sanni, K. T. (2014) for this study. The instrument was originally designed by Chislett and Chapman (2005) and adapted by Sanni, K. T. (2014). The validity and reliability of the instrument in the context of Nigeria secondary schools has been carried out by Sanni, K. T. (2014). The content validity index of the instrument was 0.75 and the reliability coefficient was 0.65 of Chronbach Alpha. Section A of the instrument elicited demographic information of the students such as school name, gender, class and age. Section B consisted of 22-items, each of these items is followed with three statements that represent the learning style preferences of the respondents in terms of visual, auditory and kinesthetic respectively. A three-point scale of "To a large extent" (3), "To a moderate extent" (2), "To a low extent" (1), was used for the respondents to rate the extent to which they prefer the three learning styles.

### 2.4. Data Analysis

Data collected through the instruments were analyzed using descriptive statistics of mean, standard deviation, frequencies, percentages, ANOVA, T-test for comparison of gender results, and Estimated Marginal Means (EMM) was also used to determine the magnitude and direction of differences among groups.

## 3. Results

### 3.1. Answers to the Research Question

R.Q 1: What is the level of students' performance in Biology when exposed to the treatments?

Table 2. *Students' performance based on treatment groups*

Score	Control group	Exp. group I	Exp. group II
0 – 12	20 (50.0)	02 (9.5)	0 (0.0)
13 – 15	07 (17.5)	05 (23.8)	0 (0.0)
16 – 18	09 (22.5)	07 (33.3)	03 (15.8)
19 – 21	04 (10.0)	05 (23.8)	07 (36.8)
22 and above	0 (0.0)	02 (9.5)	09 (47.4)
Total	40	21	19

Table 2 shows the performance of students according to their treatment groups. In the control group, 50% of the students failed the test, 50% had a credit score, and none of the students had a distinction in the group. However, in the experimental group I, 9.5% of the students failed the test, 80.9% of the students had credit score and 9.5% had distinction. In the experimental group II, none of the students failed the test, 52.6% of the students had credit pass and 47.4% had distinction. This implies that students in the control group have a low level of academic achievement in Biology compared to the other groups. Those in the experimental group I have a high level of academic achievement and those in experimental group II have the highest level of academic achievement amongst the three groups. Figure 1.0 shows the graphical representation of the students' performance in the three groups.

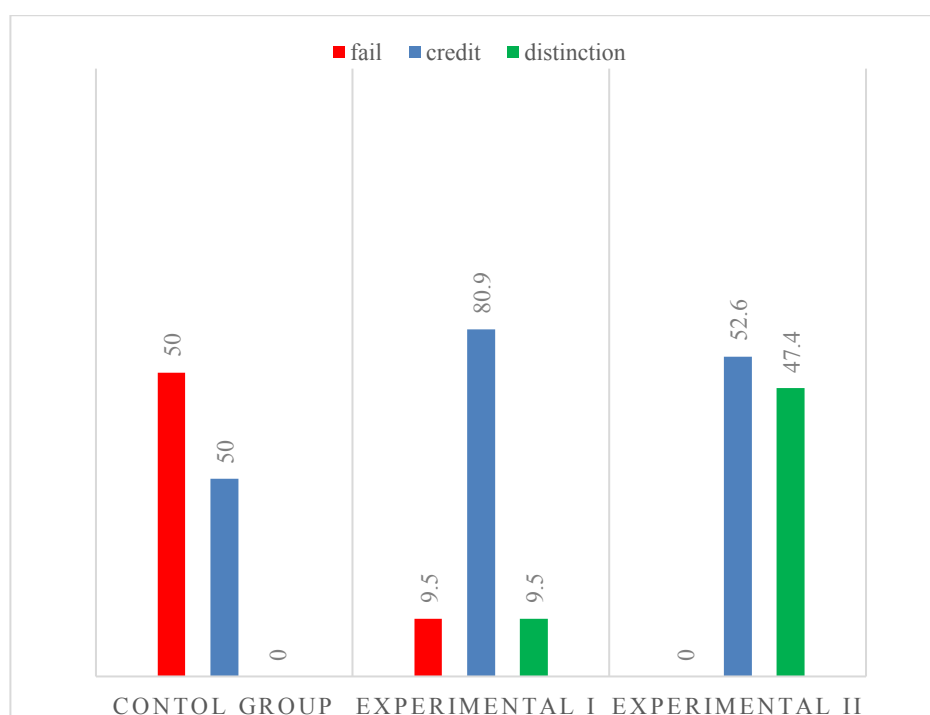


Figure 1. Graphical representation of students' achievement in BAT after treatment

### 3.2. Testing the Null Hypotheses

**H<sub>01</sub>:** There is no significant main effect of treatment on students' achievement in Biology.



Table 3. *Tests of between-subjects effects*

Dependent Variable: postscore

Source	Type III Sum Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	942.247 <sup>a</sup>	18	52.347	7.016	.000	.685
Intercept	1387.667	1	1387.667	185.988	.000	.762
prescore	27.249	1	27.249	3.652	.061	.059
trtmt	405.633	2	202.816	27.183	.000	.484
gender	29.591	1	29.591	3.966	.051	.064
learnstyle	5.275	2	2.637	.353	.704	.012
trtmt * gender	74.212	2	37.106	4.973	.010	.146
trtmt * learnstyle	30.130	4	7.533	1.010	.410	.065
gender * learnstyle	39.151	2	19.576	2.624	.081	.083
trtmt * gender * learnstyle	69.942	4	17.485	2.344	.065	.139
Error	432.740	58	7.461			
Total	22487.000	77				
Corrected Total	1374.987	76				

a. R Squared = .685 (Adjusted R Squared = .588)

Table 3 shows that there is a significant main effect of treatment on students' achievement in Biology ( $F(2, 58) = 27.18$ ;  $P < 0.05$ ; partial eta square = 0.48). Therefore,  $H_{01}$  is rejected across the three groups.

Table 4. *Estimated marginal means table*

Variable	Mean	Standard error
Intercept		
Pre score	9.08	-
Post score	17.25	.37
Treatment		
Control	13.14	.55
Experimental Group I	16.68	.65
Experimental Group II	21.94	.93
Gender		
Female	17.98	.54
Male	16.53	.50
Learning styles		
Visual	16.93	.57
Auditory	17.14	.61
Kinesthetic	17.68	.71

Table 4 reveals that students exposed to multimedia instructional package II had the highest mean score (21.94), followed by those exposed to multimedia instructional package I (16.68) while those exposed to conventional strategy scored lowest (13.14). Table 5 shows the source of significance.

Table 5. *Pair wise comparison of the groups using Scheffe's Post Hoc Test*

Treatment	Control group	Exp. group I	Exp. group II
Control group		*	*
Exp. group I	*		*
Exp. group II	*	*	

Table 5 shows that the significant difference exposed by Table 3 was as a result of the significant difference between:

Experimental group II and the experimental group I

Experimental group II and the control group

Experimental group I and the control group

The implication of this is that multimedia instructional package II is significantly better than the multimedia instructional package I, and both multimedia instructional packages I and II are significantly better than conventional teaching method in enhancing students' achievement in Biology

Ho<sub>2</sub>: There is no significant main effect of gender on students' achievement in Biology.

According to Table 3, gender has no significant main effect on students' performance ( $F(1, 58) = 3.97$ ;  $P > 0.05$ ; Partial eta square = 0.06). Therefore, Ho<sub>2</sub> is not rejected.

Ho<sub>3</sub>: There is no significant main effect of learning styles on students' achievement in Biology.

According to Table 3, learning style has no significant main effect on students' performance in Biology ( $F(2, 58) = 0.35$ ;  $P > 0.05$ ; partial eta square = 0.01). Therefore,  $H_{03}$  is not rejected

$H_{04}$ : there is no significant interaction effect of treatment, gender and learning style on students' academic performance in Biology

According to Table 3, there is no significant interaction effect of treatment, gender and learning styles on students' academic performance in Biology ( $F(4, 58) = 2.34$ ;  $P > 0.05$ ; partial eta square = 0.14). Therefore,  $H_{04}$  is not rejected.

### 3.3. Discussion and Implication of Findings

The findings of this study revealed that there is a significant difference in the academic achievement of students across the three groups. Biology ( $F(2, 58) = 27.18$ ;  $P < 0.05$ ; partial eta square = 0.48). Those exposed to the multimedia instructional packages performed significantly better than those in the control group. The reason for this higher significance might be as a result of the multimedia elements such as animations, narration, on-screen text, pictures amongst others which were used in the design of both packages. This implies that the use of multimedia instructional packages to teach bring about higher academic achievement than the conventional strategy. This finding upholds the assertion of Mayer (2009) that students learn more deeply with words and pictures when combined than they could have with either words alone or pictures alone, and that multimedia is more effective when it is interactive and under the control of the learner. This finding is therefore in line with results of some similar previous studies (Gambari, Yaki, Gana, & Ughovva, 2014; Ilhan, & Oruç, 2016; Park et al., 2019; Saputri & Indriayu, 2018) that using multimedia technique as learning media has positive effects on students learning outcome when compared to the conventional strategy, and that multimedia enhances students learning interest and efficiency. However, while this finding upholds several of Mayer (2001) principles, it does not uphold the redundancy principle which says that students learn better when animation and narration are not combined with printed text.

The higher significance of MIP II could be the result of the short video clips integrated in the package for each topic, which was not found in MIP I. Videos have been found to have the ability to focus users' attention, and provide clarity and explicitness to concepts, which was not possible with words or pictures alone. This is in line with the findings of Brame (2015) and Carmichael, Reid, and Karpicke (2018) that short videos integrated in instruction can improve academic performance of students. Therefore, integrating short videos into multimedia packages can be more compelling than graphics without video.

It was also found that learning style has no significant main effect on students' academic achievement in Biology. ( $F(2, 58) = 0.35$ ;  $P > 0.05$ ; partial eta square = 0.01). This implies that students' performance in Biology was independent of their preferred learning styles. This finding is in line with those of Cimermanova (2018); Huang et al. (2019); and Munir et al. (2018) who found that students preferred learning style does not influence learning outcome. Likewise, the result of the metadata analysis done by Ay (2017) revealed that learning types/styles only have a medium-level positive effect on student achievement. However, this finding contradicts those of Bethel-Eke and Eremie (2019); Ezzeldin (2017); and Magulod (2019), all of whom found learning styles to impact significantly on learning, and its behaviour.

An explanation to the insignificant main effect of learning styles on academic achievement seen in this study could be because computer-based multimedia instruction in the country is not commonly experienced by the students, and more specifically in public schools, from where the samples of this study were drawn. Hence, the multimedia elements integrated into

each of the lessons discussed in the experimental groups I and II respectively could have stimulated students' interests by making concepts and phenomenon real, thereby giving them the ability to focus attention, allowing for better understanding, and resulting in a higher positive effect on their academic achievement regardless of their preferred learning styles. Also, another explanation for this effect could be that the students working memory were not overloaded in the course of learning. Hence, as Moussa-Inaty et al. (2019) suggested, instructional designers should focus on designing instructions in such a way that the working memory is not overloaded, and to achieve this, instructions should be broken into units that students can focus attention at a time.

Also, it was found that gender has no significant main effect on students' academic achievement in Biology ( $F(1, 58) = 3.97$ ;  $P > 0.05$ ; Partial eta square = 0.06). This implies that the performances of male and female students in the different groups are proportionate. Male students do not perform significantly better than their female counterparts in each of the three groups. This might be because both are exposed to the same type of instruction. This result implies that the cognitive capability of male students is not significantly different from female students. Hence, if students are exposed to the same type of instruction, there is every possibility they will perform the same way. This finding is in line with that of Goni, Yagana, Ali and Bularafa (2015) that there is no significant difference between gender and academic performance of the students they studied, and also in line with some similar previous studies (such as of Abidoye, 2015; Adigun et al., 2015; Akinoso, 2018) that treatment has no significant effect on gender. However, this finding contradicts that of Heo and Toomey (2020) who found gender differences in the academic achievement of undergraduate students they studied, where their male participants performed significantly better than the female participants in all learning tasks, regardless of the type of multimedia used. This finding also contradicts that of Abdu Raheem, (2012) that males perform better than females in mathematics, science and social sciences, and that of Otutola (2017) that female students performed significantly better than males in WASSCE multiple-choice Biology test.

#### **4. Conclusion, Recommendations and Suggestions**

##### **4.1. Conclusion**

The findings of this study revealed that computer-based multimedia instructional packages can bring about meaningful learning and improved academic achievement in Biology. Therefore, it is concluded that multimedia instructional packages be utilized in secondary schools for improved academic achievement in Biology.

##### **4.2. Recommendations**

The following recommendations are made from the result of the study:

- i. The federal government should invest in the acquisition of computers, and a well-prepared computer laboratory in her secondary schools.
- ii. School administrators should be oriented about the benefits of using multimedia packages in teaching their students.
- iii. Seminars should be done for in-service teachers on how to design, develop and utilize multimedia instructional packages.
- iv. Both in-service and preservice teachers should be trained on how to use multimedia instructional packages.

#### **4.3. Challenges Encountered in the Course of the Study**

Lack of computers/poor state of computers in schools: many of the schools surveyed in the course of the study do not have computer laboratories. Some of the schools that have computers have very few functioning ones/in good and useable states. Therefore, the researcher has to go with some laptops to supplement the available ones in the selected schools for personalized instruction to be possible. This also accounts for the small sample size of the experimental groups.

#### **4.4. Suggestions for Future Studies**

The following suggestions for future studies are made:

- i. More studies could be done on the effect of learning styles on students' academic achievement. Grouping could be done on preferred learning styles, and instructions could be designed to match each group. Result of such study could be compared with those of mismatched groups and with studies like this.
- ii. The study should be replicated in different geo-political zones in the country.
- iii. More studies should be carried out that spans across more secondary schools and the result could be compared.
- iv. Studies on inhibitors to multimedia learning could also be pursued.

#### **5. Conflict of Interest**

The author declares that there is no conflict of interest.

#### **6. Ethics Committee Approval**

The author confirms that the study does not need ethics committee approval according to the research integrity rules in their country.

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