EFFECT OF MULTIMEDIA TEACHING STRATEGY ON ACADEMIC ACHIEVEMENT OF SENIOR SECONDARY SCHOOL STUDENTS IN BIOLOGY, BENUE STATE

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Abstract
This study was carried out to investigate the effect of multimedia teaching strategies on secondary school 2 students' achievement in Biology in Benue State, Nigeria. Two research questions and two hypotheses were formulated. The study adopted quasi experimental research design of non – randomized pretest posttest control group type. The population of the study was 1,070 while a sample of 168 SS2 Biology students were drawn from four secondary schools using multistage sampling technique made up of 86 males and 82 females. The research instruments were: Multimedia Instructional Package (MIP) and Biology Achievement Test (BAT).The instrument was trial-tested on 20 students. Kuder - Richardson 21 formula was used to determine the reliability coefficient of BAT which was 0.67. The research questions were answered using mean while hypotheses were tested at 0.05 level of significance using ANCOVA. The findings of the study revealed that there was a significant difference between the mean achievement scores of students taught Biology using MTS and students taught with the conventional method. There was no significant difference between the mean achievement scores of male and female students taught Biology using MTS. The study recommends that since multimedia instructional strategy has been found to enhance students' achievement in Biology, Biology teachers should be encouraged to adopt the instructional strategy for teaching topics in Biology. It was also recommended that Ministries of Education should incorporate the method in Biology curriculum.

Keywords: Multimedia, Teaching Strategy, Academic Achievement, Biology.

Introduction

In most Nigerian Secondary Schools, Biology is one of the major subjects students take at internal and external examinations. The chief examiners report of West Africa Examination Council (WAEC) (2011) noted that Biology has the largest enrollment amongst other Science subjects such as Physics and Chemistry. Students apply the knowledge they get from studying Biology in solving many social and mental problems relating to application of knowledge in real life situations, developing scientific behaviour and attitude, health issues, environmental conservation, population and birth control. Biology lessons gain more popularity and accessibility because of the availability of the Internet.

The advent of Internet, Worldwide Web and Information Communication Technology have made Biology even more popular as its teaching is no longer restricted to classroom or text book. This has also led to explosion of

knowledge on Biology and it brings about wide range of Biology literacy in the society (Akinbadewa, 2015). Despite the awareness about the importance of Biology to our everyday living, empirical evidence shows that student's performance in external examinations like WAEC is still very low compared with other Science Subjects (Abimbola & Abidoye, 2013). The chief examiners' report on WAEC for year 2010 - 2019 reflects the percentage grades of students in Biology WAEC examination which corroborate the failure rate. This shows that the educational goals and objectives set to be attained by the Federal Ministry of Education on Biology might not have been achieved. This is actually a threat to the development of the nation. Gambari, Yaki, Gana, and Ughovw (2014) noted that the implication of this failure in Secondary School Biology education is that Nigeria may have shortages of manpower in science and technology related disciplines. This already affected Nigeria's vision to become one of the 20 industrialized nations in the world by the year 2020 seeing that we are in 2023 now and it has not been actualized.

Several researchers like Yaki and Babagana (2016) have undertaken some studies to discover the causes of students' perpetual failure in Biology examinations. Njoku and Okoli (n.d) noted that among the causative factors of students' failure in Biology is Biology teachers' predominant use of ineffective teaching methods and inadequate material resources needed for effective delivery of Biology lessons. In most Nigerian schools, the major means of teaching Biology by teachers is usually the traditional method which can basically be classified into two: teacher-centered methods, which include lecture, lecture-demonstration, historical and pupil centered methods which include heuristic, assignment, project and classwork (Satyaprakasha & Sunitha, 2014; Asogwa, Muhammed, Asogwa & Ofoegbu, 2016). The persistent use of this method by teachers has submerged the great potentials of students to be creative and innovative, and their ability to think critically and of course their contribution to knowledge in the society. It also hinders meaningful learning from taking place. With several other challenges that the traditional instructional strategy has brought to the Biology classroom, researchers like Katcha and Wushishi (2015), Satyaprakasha and Sunitha (2014); Aremu and Sangodoyin (2010) and many others have taken a close look at the problem and several of them had suggested that the participation of students in Biology lessons is very important to their success in the subject. It was also suggested that teachers should use instructional strategies such as multimedia, laboratory method, guided discovery learning that seek to arouse the interest of students, stimulate thinking and concretize concepts.

Multimedia is the combination of many media which are integrated in other to bring about better usage. It is the exciting combination of computer hardwares and softwares which allows the integration of video, animation, graphics, audio, and test resources to develop effective presentations on an affordable computer (Satyaprakashai & Sunitha, 2014).

When more than two modes of instruction are used to present information which involves the use of words and pictures, it becomes a multimedia. Multimediais presenting both words (such as printed text as or spoken text) and pictures (such as illustrations, animation, photos, or video) together (Mayer, 2014).

Multimedia Teaching Strategy (MTS) is the use of appropriate and carefully selected learning experiences which are presented to the learner through selected teaching strategies which strengthen and reinforce

each other so that the learner will achieve predetermined and desired behavioural objectives (Satyaprakashai & Yaspal. 2014). If teachers move from the traditional means of passing instruction to multimedia instructional strategy in the Biology classroom, teaching and learning may be better enhanced and students' attention and interest could be better sustained.

Since the multimedia is made up of different component, which may include: sound/audio, video/movie, animation, texts and graphic, great care must be taken while planning it for classroom lesson so that each of the component will be represented adequately without being mixed up.

Sound or audio can be in form of music clip, voice over, background music and transitional music. Oladele, (2019) noted that the sound effect gives life to the whole teaching process when it is becoming dull or un appealing, it engages the interest of the students when used properly, it can also come in form of a narration to the graphics or animation that is being displayed which actually gives more meaning to the presentation. Sound can also provide emphasis on some important information to the students; it can be used as a means of transition from one page to another. Teachers can as well present a lot of information at once when the sound is well adjusted to screen display (Angadi & Ganihar. 2015).

Video clip has been viewed to be real to students because of its ability to present the information in actual form. Ogochukwu (2010) sees video as more beneficial to students for its ability to take the students beyond the classroom experience. Videos can be used to give examples of phenomena or issues referred to in the text (Angadi & Ganihar. 2015).

Animation is another form that multimedia can be presented. Pictures or objects are made to move in a way that can give meaning to students. This movement can be timed to accommodate the students pace of learning; it presents the object of study to the students in a drawing movement form that best illustrates the demonstrated concept (Gambari, Yaki, Gana & Ughovwa, 2014).

Text makes a multimedia presentation adequate and understandable by its users. If texts are well-arranged, written and programed and made to come in to the mode of presentation at the adequate time, it gives better understanding to the students than using sounds and animation in the presentation (Angadi & Ganihar. 2015).

Graphics make room for the most creative possibilities for a learning session in multimedia. They can be photographs, drawings, graphs from a spreadsheet, materials downloaded from the internet, or pictures from CD-ROM (Angadi & Ganihar, 2015). Graphics gives the pictorial view to the whole process and communicate the idea better to the student in picture.

This study is anchored on the Cognitive theory of multimedia learning (CTML) by Mayer (1997) and the Dual-Coding theory as propounded by Paivio in 1986. CTML centers on the idea that learners attempt to build meaningful connections between words and pictures and that they learn more deeply than they could have with words or pictures alone. Mayer's CTML suggests that students can only process a certain amount of information at a time. Paivio describes two ways in which a man can expand on learned material, which are verbal association and visual imagery**.** The theory states that both verbal and visual information is used to represent information. Verbal and visual

information are processed separately, and along different channels in the human mind. Empirical studies such as that by (Satyaprakashai & Yaspal, 2014), shows that no single media can bring about meaningful learning in students, as a result the teacher must design the multimedia package in such a way that there would be integration between the chosen media. These media can be combined in various forms as much as it brings about meaningful learning in students, because the memory of each student is limited with quantity of information it can stored at any given time, this paper integrated sound (audio), animation and text. Multimedia instructional method helps students to process the same information in different media at the same time bring about meaningful learning, which help learners to build adequate mental model, analyze the information and retain it properly better than they do in the traditional classroom sessions (Oladele, 2019). Students' achievement in Biology could either be low or high, it is low when the students do not attain up to the desired expectation or bench make of the instructor, and it is high when the performance of the learners is exactly or above the desired outcome of the instructor. Several factors could be accounted for the low or high achievement in Biology such factors includes: the environment of the learner, learner's attitude, the nature of the subject, instructor, availability of textbooks and instructional materials, and the instructional strategy used by the teacher (Dinah, 2013). This implies that if students' achievement in Biology will be improve upon, new and innovative teaching method like multimedia Teaching strategy must be used to effectively teach the student in the Biology classroom because it will avail learners the opportunity to see, view, and possibly hear instructions that are perceived to be difficult in Biology in more simpler method. It is against this backdrop that this paper is out to distinct the effect of MTS

Research Questions

The following questions were raised to guide the study:

1. What are the mean achievement scores of students taught Biology using MIS and those taught without MIS?
2. What are the mean achievement scores of male and female students taught Biology using MIS?

Hypotheses

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

1. There is no significant difference between the mean achievement scores of students taught Biology using MIS and those taught without MIS
2. There is no significant difference between the mean achievement scores of male and female students taught Biology using MIS.

Methodology

This study adopted the quasi-experimental design, using the non- randomized pretest-posttest, non-equivalent control group design. The population of the study consists of 1070 senior secondary school II students of Biology (SS 2) in three Local Government Areas of Benue State. The SS 2 students were chosen because they are not currently preparing for any external examination, they are also familiar with Biology, and they have also been exposed to the traditional way of teaching Biology from SS1.

The sample for this study was drawn from the SS2 students of Biology. Four schools in the state were selected using multistage

sampling technique; Purposive sampling technique was used to select the schools that were involved in the study.

In each of the four schools selected, simple random sampling was used to select one intact class, the sample size for the study is 168 students, drawn from four schools two of which were designated experimental while the other two were the control. The experimental groups were taught with the multimedia instructional package (MIP) while the control groups were taught using the conventional teaching method or lecture method.

The instrument for the study was Biology Achievement Test **(**BAT) which was adapted from WAEC past questions on topics that are related to the content covered in the lesson plans. The BAT consists of two sections, section A contains the background information on the respondents (class, time allowed and sex) while section B contains the questions. The trial-testing was carried out to determine the internal consistency of the instruments. The result collected from BAT was analyzed using Kuder-Richardson 21 formula which yielded a reliability coefficient of 0.67, this formula was used because the items are scored dichotomously BAT consists of 30 items which are multiple-choice objective questions with four options (A, B, C, & D) in which the students are expected to pick one they consider as the correct option. The total mark obtainable from BAT is 30 marks.

Multimedia Instructional Package **(**MIP). The lessons of the package was designed by the researcher based on multimedia cognitive principles of learning as explained by Mayer (2005). The package was designed using the software package Scratch mBlock version (3.2.2) developed by the Massachusetts Institute of Technology (MIT) media laboratories (2014). The MIP was used in teaching the experimental group after the pre-test. The package includes content on unit 3 topics of Biology curriculum for SS2 students which Nutrient cycle in nature and Ecological management. Text, sounds, narration and images were the elements of Multimedia used in designing the package.

After the design of the MIP, the researcher gave it to an Educational technologist specialist, three Biology teachers for face and content validity the report from their observation was effected, on the package before taking it to the field, and it was trial tested on a representative sample of 30 SS 2 students.

The researcher and the assistants' administered the pre – test to the students that participated in the study. Thereafter, the research assistants' taught Biology with MIP to the experimental group and conventional teaching method was used for the control group. The teaching lasted for four weeks after which a post- test (BAT) was administered to the students. Mean was used to answer the research questions, because it is a discreet data. Inferential statistics of Analysis of Covariance was used to test the formulated hypotheses at $p \leq 0.05$ level of significance. The choice of ANCOVA is due to the fact that it statistically removes the initial differences across the non- randomized groups. This level of significance formed the basis for rejecting or not rejecting each of the hypotheses.

Results

Research Question 1: What are the mean achievement scores of students taught Biology using MIS and those taught with conventional method?

Table 1: Mean Achievement Scores of Students Taught Biology using MIS and those Taught with Conventional Method.

Group	**N**	Pre-BAT		Post-BAT		Mean Gain
		X	SD	X	SD	
MIS	85	6.78	3.30	20.82	5.62	14.04
Conventional Teaching Method (MTM	83	7.57	2.91	12.60	3.29	5.03
Mean Diff.		0.79		8.22		9.01

In Table 1, the result shows the mean achievement scores of students taught Biology with MIS and those taught with convention method. The result shows that in the pre-test, the students taught Biology with MIS had a mean score of 6.78, while the students taught Biology with the conventional method had a mean score of 7.57. The mean difference in the pre-test examination is 0.79 which is an indication that the two groups are having the same previous knowledge before the post-test examination. The result also shows that in the post-test examination, the students taught Biology had a mean score of 20.82, while the students in the control group had a mean score of 12.60. The mean difference between the two groups is 8.22 and this was in favour of the students taught Biology with MIS. To show if the achievement of MIS students is significant, hypothesis one was tested at 0.05 level of significance.

Hypothesis 1: There is no significant difference between the mean achievement scores of students taught Biology with MIS and those taught without MIS. The result to this hypothesis is presented in Table 2:

Table 2: Result of ANCOVA of Achievement Scores for Students Taught Biology Using MIS and Those Taught without MIS.

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	1072.104[a]	2	536.052	9.572	.000	.135
Intercept	2820.617	1	2820.617	50.368	.000	.291
Pretest	880.283	1	880.283	15.719	.000	.113
T.Method	**47.927**	**1**	**47.927**	**.856**	**.001**	**.007**
Error	6888.031	123	56.000			
Total	559327.000	168				
Corrected Total	7960.135	165				

In Table 2, the result of the Analysis of Co-variance shows that the P-value of 0.001 is less than the alpha value of 0.05 level of significance. The result implies that there is statistically significant difference in the mean achievement scores of students taught Biology with MIS and those taught without MIS. Therefore, the null hypothesis of no significant difference is rejected.

Research Question 2: What are the mean achievement scores of male and female students taught Biology using MTS?

Table 3: Mean Achievement Scores of Male and Female Students Taught Biology using MTS.

Group	**n**	Pre-BAT		Post-BAT		Mean Gain
		X	SD	X	SD	
Male	46	10.45	3.82	13.58	8.48	3.13
Female	39	9.70	4.15	13.03	8.09	3.33
Mean Diff		0.75		0.55		0.2

In the Table the result shows the mean achievement scores of the male and female students taught with MTS. The result showed that in the pre-test, the male students had a mean score of 10.45, while the female students had a mean score of 9.70. The mean difference in the pre-test examination is 0.75 which is an indication that the two groups are at the same previous knowledge before the post-test examination. The result also shows that in the post-test examination, the male students had a mean score of 13.58, while the female students had a mean of 13.03. The mean difference between the two groups is 0.55 and this is an indication that both groups are at the same cognitive level after the application of treatment.

Hypothesis 2: There is no significant difference between the mean achievement scores of male and female students taught Biology with MIS. To show if the achievement of male and female students is significant, hypothesis two was tested at 0.05 level of significance. The result of the hypothesis is presented in Table 4.

Table 4: ANCOVA Result of Achievement Scores of Male and Female Students taught Biology using MIS.

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	90.908[a]	2	45.454	.908	.408	.025
Intercept	4905.531	1	4905.531	98.008	.000	.576
Pretest	89.116	1	89.116	1.780	.186	.024
Gender	**3.671**	**1**	**3.671**	**.073**	**.087**	**.001**
Error	3603.759	72	50.052			
Total	321871.000	85				
Corrected Total	3694.667	84				

The result of the Analysis of Co-variance presented in Table 4 shows that the P-value of 0.087 is greater than the 0.05 level of significant at 1 degree of freedom. This shows that the hypothesis is not significant. The result implies that there is no statistical significant difference in the mean achievement scores of male and female students taught Biology with MIS. Therefore, the null hypothesis of no significant difference is not rejected.

Discussion of Findings

The result of the study in Table 1 and 2showed there is a significant difference in the mean achievement of SS2 students taught Biology with MIS and those taught without MIS. This implies that the experimental group improved on their achievement in Biology than the control group. In this case, the study concludes that learning Biology

using MIS improved students' achievement in the subject.

The findings give credence to what was earlier found by Satyaprakasha and Sunitha (2014), Oladele (2019) that Biology students taught with multimedia improve more in their achievement than their counterparts taught without multimedia. This finding is also in line with Aremu and Sangodoyin (2010), Glomo-Narzoles (2013) who reported that computer based instruction bring about a higher gain in achievement when compared with the conventional teaching method.

The answer to research question two was provided on Table3 .The result indicates the mean achievement score of male and female students taught Biology using the MIS. At the same time, analysis of covariance was employed for testing hypothesis 2, the F – calculated value for gender was 0.087 confirming that there was no significant difference between the mean achievement scores of male and female students in the experimental group. These might be because the two groups were exposed to the same instruction with multimedia and the lessons were captivating. The result of this study is in line with the findings of Gamabari *et.*al (2005), Aremu and Sangodoyin (2010), Katcha and Wushishi (2015), Oladele, (2019) who found that there was no significant difference in the performance of male and female students exposed to MTS.

Based on the findings of this study, it is concluded that the use of MTS enhances students' achievement. This implies that the continual poor achievement of students in Biology can be improved upon if Biology teachers adopt the use of multimedia instructional strategy as part of the teaching methods used in the Biology classroom. It is concluded that the use of MTS enhances student's achievement irrespective of gender. Therefore, the use of conventional method alone should be de-emphasized.

The following recommendations are made based on the findings of this study

1. Ministries of Education, State Secondary school Education Boards and other Educational stakeholders are encouraged to promote the use of MTS in schools by organizing conferences, seminars and workshops for serving Biology teachers to learn or update themselves on the use of MTS.
2. Biology teachers should incorporate MTS in teaching Biology so as to promote and encourage social interactions, self-motivation and active engagement among learners as well as promote gender equity.
3. Curriculum planners and textbook authors should include MIS in Biology curriculum and Biology textbook as complementary to other teaching methods.
4. School Administrators and inspectors should ensure Biology teachers incorporate the use of MTS in Biology teaching.

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