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Effect of Multimedia Instructional Strategies on Secondary School Students' Academic Achievement and Retention in Basic Science and Technology in Makurdi LGA, Benue State

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ABSTRACT

The study investigated the effect of multimedia instructional strategies on secondary school students' academic achievement and retention in Basic Science and Technology in Makurdi LGA. Four research questions were asked and answered and four hypotheses were tested at 0.05 level of significance. A pre-test post-test quasi-experimental research design was adopted for the study. The population of the study was 7,834 upper basic two students. Simple random sampling techniques was used to sample 84 (46 Male and 38 Female) students in two intact classes from the population. Basic Science and Technology Achievement Test (BSTAT) and Basic Science and Technology Retention Test (BSTRT) were used as instrument for data collection. A reliability coefficient of 0.88 was obtained using, kuder-Richardson 20 formula. Data were analyzed using mean and standard deviation, to answer research questions while the null hypotheses were tested using analysis of Covariance (ANCOVA). Findings of the study showed that there is a statistically significant difference between the mean achievement and retention scores of students taught Basic Science and Technology with multimedia instructional strategy and those taught using lecture method amongst others. Based on the results of the findings, the researcher concludes that the method employed in teaching Basic Science and Technology has significant effects on students' achievement and retention. Students significantly achieve higher and retained more when taught using multimedia instructional strategy. Therefore, it was recommended amongst others that Basic Science and Technology teachers should endeavour to use multimedia in the teaching of Basic Science and Technology, especially in secondary schools.

KEYWORDS: Multimedia, Achievement, Retention, Basic Science and Technology, and Secondary School Students.

Introduction

Science and technology have always been recognized as critical factors in the process of development. Through its application, the resources of nations have been transformed into goods and services all over the world. Abdulkadir (2011) remarked that the current

development in science and technology has greatly affected the lives of every human being such that, to be ignorant of the basic knowledge of this development is to live an empty, meaningless and probably unrealistic life. For any nation to attain the status of self -reliance, science must be an important component of that nation irrespective of race, creed or sex. Science can be defined as the systematic body of knowledge obtained by methods or techniques based on observation and experimentation as its authority. It seeks to explain the natural phenomenon using enquiry processes or activities. The branches of science that makes up Basic Science and Technology are: Biology, Physics, Chemistry, among others.

Basic Science and Technology is a core subject at the Junior Secondary School (JSS) level in Nigeria, introduced to lay the foundation for scientific knowledge and stimulate students' interest in science-related disciplines. The Nigerian Educational Research and Development Council (NERDC, 2007) emphasizes that the Integrated Science curriculum is intended to develop students' skills in observation, experimentation, and critical thinking, thereby preparing them for further studies in science and technology. However, evidence suggests that students' achievement and retention in Basic Science and Technology remain low, especially in public secondary schools across Benue State (Agbo-Egwu, 2010; Okebukola, 2012). Conventional instructional strategies commonly used in classrooms, such as the lecture method, have been criticized for being teacher-centered and ineffective in stimulating students' interest and active participation (Obeka, 2011). These methods often fail to cater to diverse learning styles and do not provide students with the opportunity to interact meaningfully with the content. According to Ezeudu (2013), the lack of effective, engaging, and learner-centered approaches contributes significantly to poor achievement and low retention rates in science subjects.

Academic achievement of Upper Basic Schools students is an important factor affecting the achievement of higher education goals (Zhu, 2016). Academic achievement is a direct manifestation of learning effectiveness and a valid indicator to evaluate the effectiveness of teaching. Achievement refers to the completion and attainment of a certain level that a student can achieve after a series of education or training (Lamas, 2015). It is the result obtained through study which represents performance outcomes that indicate the extent to which a student has accomplished specific goals that were the focus of activities in instructional environments, specifically in school, college, and university (Cai & Cao, in Zheng & Mustapha, 2022). To address the poor achievement of students, efforts have been made by science education scholars towards making Basic Science and Technology simple. This has not yielded the desired result, (Ityobee, *et. al.,* 2024). The poor academic achievement of male and female students is linked primarily to the fact that the concepts taught are not retained by learners (Jackman & Morrain-Webb, 2019).

Retention is the ability to store what has been learnt and recall what has been stored in the memory, Olarewaju, (2017). The nature of the material to be coded contributes to the level of retention. Instructional strategies contribute to quality and level of retention in terms of concreteness, Ugwu *et,al,* (2020). Retention could be explained as the process or ability to retain and remember things and experiences learned by an individual at a later time. Students' retention of lesson content is a function of student ability to properly conceptualize what is learnt or being taught. The use of multimedia technologies in the classroom have been shown in a number of studies to impact positively on the students' retention, (Nwanze, *et,al.,* 2021). This is because students' can hardly forget lesson contents that involve many of their senses

when various multimedia formats are used as against when conventional teaching method such as lecture method is employed.

Gender is another factor that could influence students' achievement and retention in a subject. It is a variable that has so much effect on both teachers and students in the teaching and learning processes (Ityobee, *et. al.,* 2024). Gender differences in academic achievement have been of great concern to researchers and education policy makers, both at local and international levels. It is one of the current academic issues under deliberations all over the world (Abdu-Raheem, 2012). Today, equality between boys and girls has become a major scourge plaguing the world, particularly in developing countries and also in sciences. In society today, girls are looked at as second-class citizens, which does not help nurture their careers in sciences (Abdu-Raheem, 2012). These issues have been challenges in the educational sector.

In response to this educational challenge, multimedia instructional strategies have emerged as a promising alternative. Njoku in Akoja and Ali (2012) stated that multi-media instructional strategies are those channels of communication which promote the effectiveness of instruction and help the teacher to communicate ideas effectively to his students. Multi-media instructions are those alternative channels of communication which a Basic Science and Technology teacher can use to concretize a concept during his/her teaching. Multi-media instructional strategies include all the materials and substantial resources that an educator might use to implement instruction which facilitates students' achievement and retention of knowledge. It involves the use of text, graphics, audio, video, and animation in an integrated manner to enhance learning experiences (Ayoade, 2015). It appeals to multiple senses and provides interactive learning environments that encourage active learner engagement, thereby improving understanding and retention. Studies by Okwo and Ike (2015) and Omoifo (2012) have shown that multimedia instructional strategies can significantly improve students' academic achievement and facilitate long-term retention in science education.

Despite the growing body of literature on the benefits of multimedia in science education, there is a dearth of localized studies focusing on Integrated Science in Makurdi, Benue State. Yusuf and Bello (2020) note that the integration of multimedia tools in science teaching not only increases students' motivation but also enhances achievement and long-term knowledge retention. Therefore, this study seeks to investigate the effect of multimedia instructional strategies on secondary school students' achievement and retention in Basic Science and Technology in Makurdi, Benue State.

Objective of the Study

The Objective of this study is to investigate the Effect of Multimedia Instructional Strategies on Secondary School Students' Academic Achievement and Retention in Basic Science and Technology in Makurdi LGA., Benue State. Specifically, the study sought to:

1. To find out the different in the mean achievement score of students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method;

2. To find out the difference in the mean retention score of students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method;

3. To find out the difference in the mean achievement score of male and female students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method;

4. To find out the different in the mean retention score of male and female students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method.

Research Questions.

The following research questions were raised and answered.

1. What is the difference in the mean achievement score of students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method?

2. What is the difference in the mean retention score of students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method?

3. What is the difference in the mean achievement score of male and female students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method?

4. What is the difference in the mean retention score of male and female students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method?

Hypothesis

The following hypotheses were formulated for the study and tested at 0.05 alpha level.

1. There is significant difference in the mean achievement score of students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method.

2. There is significant difference in the mean retention score of students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method.

3. There is significant difference in the mean achievement score of male and female students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method.

4. There is significant difference in the mean retention score of male and female students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method.

METHODOLOGY

The researcher adopted a quasi-experimental research design of non-equivalent group for the study. Specifically, the study adopted a non-randomized pre-test, post-test control group design.

The study was carried out in Makurdi Local Government Area (LGA), Benue State. The population of the study was 7,834 upper basic two students in 55 secondary schools. The sample size for the study was 84 (46 male and 38 female) Upper Basic II (JSS2) students. The study used Basic Science and Technology Achievement Test (BSTAT) and Basic Science and Technology Retention Test (BSTRT) as instrument for data collection. The instrument was validated by two (2) experts and the reliability coefficient was established to be 0.88 using kuder-Richardson 20 formula. The data collected were analyzed using mean and standard deviation to answer the research questions and analysis of covariance (ANCOVA) to test the hypothesis.

RESULTS AND DISCUSSION

Results

The results of the study were presented according to research questions answered and hypotheses tested as follows:

Research Question 1

What is the difference in the mean achievement score of students taught Basic Science and Technology using multi-media instructional strategy and those taught using the lecture method?

Table 1: Mean and Standard Deviation Scores of Students taught Basic Science and Technology with Multi-media Instructional Strategy and those Taught using Lecture Method

Group	N	Pre-BSTAT		Post-BSTAT		Mean Gain
		Mean	SD	Mean	SD	
Multi-media	44	21.82	2.05	29.36	3.35	**7.54**
lecture method	40	21.83	2.11	27.00	4.10	**5.17**
Mean Difference		**0.01**		**2.36**		**2.37**
Total	**84**					

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The results presented in Table 1, shows that the mean achievement scores of students taught Basic Science and Technology multi-media instructional strategy was 21.82 for pre-test and 29.36 for the post-test with corresponding standard deviation of 2.05 and 3.35 respectively. However, the mean achievement scores of students taught Basic Science and Technology using the lecture method was 21.83 for the pre-test and 27.00 for the post-test, with standard deviation of 2.11 and 4.10 respectively. The mean gain for the multi-media group was 7.54 while the lecture method group was 5.17. The group mean difference was 0.01 for pre-test and 2.36 for post-test while the mean gain was 2.37 in favor of the multi-media group.

Research Question 2

What is the difference in the mean retention score of students taught Basic Science and Technology using multi-media instructional strategy and those taught using the lecture method?

Table 2: Mean and Standard Deviation of Retention Scores of Students taught Basic Science and Technology with Multi-media Instructional Strategy and those Taught using Lecture Method

Group	N	Post-BSTAT		Retention-BSTAT		Mean Gain
		Mean	SD	Mean	SD	
Mult-media	44	29.36	3.35	30.52	2.40	**1.16**
Lecture Method	40	27.00	4.10	26.70	3.93	**0.30**
Mean Difference		**2.36**		**3.82**		**0.86**
Total	**84**					

The results presented in Table 2, shows that the mean retention scores of students taught Basic Science and Technology with multi-media instructional strategy was 29.36 for post-test and 30.5 for the retention test with corresponding standard deviation of 3.35 and 2.40 respectively. However, the mean retention scores of students taught Basic Science and Technology with the lecture method was 27.00 for the post test and 26.70 for the retention test, with standard deviation of 4.10 and 3.93 respectively. The mean gain for the multi-media group was 1.16 while the lecture method group was 0.30. The group mean difference was 2.36 for post-test and 3.82 for retention test while the mean gain was 0.86 in favor of the multi-media group.

Research Question 3

What is the difference in the mean achievement score of male and female students taught Basic Science and Technology using multi-media instructional strategy and those taught using the lecture method?

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Table 3: Mean and Standard Deviation Scores of Male and Female Students taught Basic Science and Technology with Multi-media Instructional Strategy.

Group	N	Pre-BSTAT		Post-BSTAT		Mean Gain
		Mean	SD	Mean	SD	
Male	23	21.22	2.37	28.13	3.40	**6.91**
Female	21	22.48	1.40	30.71	2.78	**8.23**
Mean Difference		**1.26**		**2.58**		**1.32**
Total	**44**					

The results presented in Table 3, shows that the mean achievement scores of male students taught Basic Science and Technology with multi-media instructional strategy was 21.22 for pre-test and 28.13 for the post-test with corresponding standard deviation of 2.37 and 3.40 respectively. However, the mean achievement scores of female students taught Basic Science and Technology using the multi-media instructional strategy was 22.48 for the pre-test and 30.71 for the post-test, with corresponding standard deviation of 1.40 and 2.78 respectively. The mean gain for the male students was 6.91 while the female students was 8.23. The group mean difference was 1.26 for pre-test and 2.56 for post-test while the mean gain was 1.32 in favor of the female students.

Research Question 4

What is the difference in the mean retention score of male and female students taught Basic Science and Technology using multi-media instructional strategy and those taught using the lecture method?

Table 4: Mean and Standard Deviation of Retention Scores of Male and Female Students taught Basic Science and Technology with Multi-media Instructional Strategy.

Group	N	Post-BSTAT		Retention-BSTAT		Mean Gain
		Mean	SD	Mean	SD	
Male	23	28.13	3.40	29.83	2.39	**1.70**
Female	21	30.71	2.78	31.29	2.24	**0.58**
Mean Difference		**2.58**		**1.46**		**1.12**
Total	**44**					

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The results presented in Table 4, shows that the mean retention scores of male students taught Basic Science and Technology multi-media instructional strategy was 28.13 for post-test and 29.83 for the retention test with corresponding standard deviation of 3.40 and 2.39 respectively. However, the mean retention scores of female students taught Basic Science and Technology using the multi-media instructional strategy was 30.71 for the pre-test and 31.29 for the post-test, with corresponding standard deviation of 2.78 and 2.24 respectively. The mean gain for the male students was 1.70 while the female students was 0.58. The group mean difference was 2.58 for post-test and 1.46 for retention test while the mean gain was 1.12 in favor of the male students.

Hypothesis 1

There is significant difference in the mean achievement score of students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method.

Table 5: Analysis of Covariance of Academic Achievement Scores of Students taught Basic Science and Technology using Multimedia Instructional Strategy and those taught using Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	340.394[a]	2	170.197	15.012	.000	**.270**
Intercept	88.292	1	88.292	7.788	.007	**.088**
Pretest	220.849	1	220.849	19.480	.000	**.194**
Group	**120.085**	**1**	**120.085**	**10.592**	**.002**	**.116**
Error	918.308	81	11.337			
Total	68183.000	84				
Corrected Total	1258.702	83				

a. R Squared = .270 (Adjusted R Squared = .252)

The result of the Analysis of Covariance presented in Table 5 shows that the P-value of 0.002 is less than .05 (P<0.05) level of significance. This shows that the test was significant. Therefore, the null hypothesis was rejected. The result implies that there is a statistically significant difference between the mean achievement scores of students taught Basic Science and Technology with multimedia instructional strategy and those taught using lecture method. This means that students who were exposed to multimedia instructional strategy achieved higher than those not exposed to multimedia instructional strategy.

Hypothesis 2

There is significant difference in the mean retention score of students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method.

Table 6: Analysis of Covariance of Retention Scores of Students taught Basic Science and Technology with Multimedia Instructional Strategy and those taught with Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1009.884[a]	2	504.942	276.962	.000	**.872**
Intercept	59.107	1	59.107	32.420	.000	**.286**
Postest	703.702	1	703.702	385.982	.000	**.827**
Group	**71.761**	**1**	**71.761**	**39.361**	**.000**	**.327**
Error	147.675	81	1.823			
Total	70359.000	84				
Corrected Total	1157.560	83				

a. R Squared = .872 (Adjusted R Squared = .869)

The result of the Analysis of Covariance presented in Table 6 shows that the P-value of 0.000 is less than .05 (P<0.05) level of significance. This shows that the test was significant. Therefore, the null hypothesis was rejected. The result implies that there is a statistically significant difference between the mean retention scores of students taught Basic Science and Technology with multimedia instructional strategy and those taught using lecture method. This means that students who were exposed to multimedia instructional strategy retained more than those not exposed to multimedia instructional strategy.

Hypothesis 3

There is significant difference in the mean achievement score of male and female students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method.

Table 7: Analysis of Covariance of achievement Scores of Male and Female Students taught Basic Science and Technology with Multi Media Instructional Strategy and those taught with Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	255.049[a]	2	127.524	23.020	.000	**.529**
Intercept	13.734	1	13.734	2.479	.123	**.057**
Pretest	181.761	1	181.761	32.810	.000	**.445**
Group	**15.629**	**1**	**15.629**	**2.821**	**.101**	**.064**
Error	227.133	41	5.540			
Total	38420.000	44				
Corrected Total	482.182	43				

a. R Squared = .529 (Adjusted R Squared = .506)

The result of the Analysis of Covariance presented in Table 7 shows that the P-value of 0.101 is greater than .05 (P>0.05) level of significance. This shows that the test was not significant. Therefore, the null hypothesis was not rejected. The result implies that there is no statistically significant difference between the mean achievement score of male and female students taught Basic Science and Technology with multimedia instructional strategy.

Hypothesis 4

There is significant difference in the mean retention score of male and female students taught Basic Science and Technology using multi-media instructional strategy and those taught using the traditional method.

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Table 8: Analysis of Covariance of Retention Scores of Male and Female Students taught Basic Science and Technology with Multi Media Instructional Strategy and those taught with Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	155.288[a]	2	77.644	33.978	.000	**.624**
Intercept	89.579	1	89.579	39.201	.000	**.489**
posttest	131.901	1	131.901	57.722	.000	**.585**
Group	**.001**	**1**	**.001**	**.000**	**.987**	**.000**
Error	93.689	41	2.285			
Total	41241.000	44				
Corrected Total	248.977	43				

a. R Squared = .624 (Adjusted R Squared = .605)

The result of the Analysis of Covariance presented in Table 8 shows that the P-value of 0.987 is greater than .05 (P>0.05) level of significance. This shows that the test was not significant. Therefore, the null hypothesis was not rejected. The result implies that there is no statistically significant difference between the mean retention score of male and female students taught Basic Science and Technology with multimedia instructional strategy.

Discussion

The findings in research question and hypothesis one revealed that there is a statistically significant difference between the mean achievement scores of students taught Basic Science and Technology with multimedia instructional strategy and those taught using lecture method. The findings of this study are supported by the findings of Umar *et,al*. (2016), who found that there was significant difference in the student's achievement scores in favouring students in the experimental group. Also, the findings of the study are in agreement with the findings of Nwaze *et,al* (2018), who found that there is a significant difference between the mean achievement scores of students exposed to multimedia integrated lessons and the convectional group. The findings of the study are also in agreement with the findings of John *et,al* (2018), who found that students taught biology with multimedia instructional strategy performed better than those taught with lecture method. However, the findings of this study negate the findings of Awolaju (2016), who found that there is no significant difference between pre-test scores and post- test scores of experimental groups. This difference could be as a result of the different in the subject area and class taught.

The findings in research question two and hypothesis two revealed that there is a statistically significant difference between the mean retention scores of students taught Basic Science and

Technology with multimedia instructional strategy and those taught using lecture method. This finding is supported with the findings of Nwanze *et,al* (2021), who found that the Multimedia group had a significantly higher retention score, performed better than those in the convectional group taught with modified lecture method. Again, the findings of the study are in agreement with the findings of Umar *et,al*. (2016), who found that there was significant difference in the student's retention mean scores in favouring students in the experimental group.

The findings in hypothesis three revealed that there is no statistically significant difference between the mean achievement score of male and female students taught Basic Science and Technology with multimedia instructional strategy. The finding of this study is in agreement with findings of Enebech (2023), who found that was no significant difference in the achievement scores of male and female students taught with educational media. Additionally, the findings of this study also agree with the findings of Awolaju (2016), who found that the post test scores of male and female students taught with multimedia instructional materials showed no significant difference between their mean scores.

The finding in hypothesis four revealed that there is no statistically significant difference between the mean retention score of male and female students taught Basic Science and Technology with multimedia instructional strategy. This finding is in agreement with the findings of Enebechi (2023), who found no significance different in the mean retention score of male and female students taught biology with the use of educational media. Again, the findings of the study agree with the findings of Awolaju (2015), who found no significance difference in the retention of male and female students taught with multimedia instructional materials.

Conclusion

Based on the results of the findings, the researcher concludes that the method employed in teaching Basic Science and Technology has significant effects on students' achievement and retention. Students significantly achieve higher and retained more when taught using multimedia instructional strategy.

Recommendations

Based on the findings of the study, the following are hereby recommended:

1. Basic Science and Technology teachers should endeavour to use multimedia in the teaching of Basic Science and Technology, especially in secondary schools.

2. Multimedia instructional strategy is gender friendly and should therefore be used in teaching of Basic Science and Technology to enhance male and female students' retention in the subject.

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