

Digital Devices and Secondary School Students' Achievement in Biology in Eket Local Government Area, Akwa Ibom State, Nigeria

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ABSTRACT

This study examined the effects of digital devices on secondary school students' achievement in Biology in the Eket local government area of Akwa Ibom State. The design of the study was a quasi-experimental design using a pre-test and post-test non-randomized control group. The population was all the Senior Secondary one (SS1) Biology students for the 2020/2021 session in all the public Secondary Schools in Eket local government area. A total of 150 students constituted the sample for the study (50 students in experimental group one, 47 students in experimental group two, and 53 students in the control group). Biology Achievement Test (BAT) was used for data collection with a reliability index of 0.78. The instrument was designed by the researchers and validated by a panel of experts, one from the Biology Department and the other from Measurement and Evaluation, Department of Science Education, Akwa Ibom State University. Two research questions and two hypotheses guided the study. The hypotheses were analyzed using Analysis of Covariance (ANCOVA) at a 0.05 significant level. The findings showed that students achieved better using mobile phones and projectors compared to the expository learning strategy in the concept of nutrition in Biology; female students significantly outperformed their male counterparts. Consequently, mobile phones should be used by students in the learning of concepts in Biology.

Keywords: Biology, projector, mobile phone, students' achievement

INTRODUCTION

Biology is a branch of natural science that deals with living organisms, including their structures, functions, evolution, distribution, and interrelationships. It occupies a unique position in the secondary school curriculum because of its importance as the science of life. In Nigeria, the secondary school Biology curriculum is designed to help students investigate natural phenomena, deepen understanding and interest in biological sciences, and to encourage student's ability to apply scientific knowledge to everyday life in a matter of

personal, community, health, and agriculture among others (Federal Ministry of Education, 2017).

Akwa Ibom State government has made efforts to encourage the study of science, such include organizing science quiz competitions for students and seminars and workshops for Biology, and other Science, Technology, Engineering, and Mathematics (STEM) teachers. The Science Teachers Association of Nigeria (STAN) works assiduously towards Science Education in Nigeria. Despite these efforts, students' achievement in biology at the Senior School Certificate Examination (SSCE) has not been encouraging.

Biology teaching and other sciences in Nigerian schools are still dominantly organized and conducted traditionally; students' activities during classes are passive listening, receptive learning, and rote memorization. In such teaching, students' opinions are often neglected, especially creative thinking, reflection on their lives, and searching for new ideas. There are several factors responsible for students' poor achievement in biology. The factors include a lack of adequate instructional materials, instructional approach, lack of laboratory activities (Ibitoye & Fape, 2017; Okebukola, 2014), use of ineffective methods of teaching (Onwuegbu & Nworgu, 2013; Okoyefi, 2014), overloaded Biology syllabus (Osuafor & Okigbo, 2013). Ineffective instructional approaches at the senior secondary school level in Nigeria are the major factors leading to students' poor achievement in Biology examinations (Gambari, Yaki, Gana & Ughovwa, 2014). Omoniyi (2016) revealed that instructional approaches lead to poor achievement and retention in science. Students' retention of Biology content is facilitated by an instructional approach that links the present learning with previous learning.

Thus, biology teaching and learning, supported by Information and Communication Technologies, offers an alternative to the solutions used in the traditional lecture-based approach. Learner-centered approaches to technology-enabled learning can empower learners and leverage good learning experiences that would not otherwise have been possible (Dumont, Instance & Benavides, 2014). There is a need to employ innovative teaching/learning approaches in the teaching and learning of Biology. Examples of innovative instructional approaches are computer-aided instruction, computer animation, cooperative learning, simulation, jigsaws, inquiry-based learning, use of digital devices (projector, mobile phone). If innovative approaches are effectively utilized in the classroom during instructional processes, they lead to more enhanced and improved learning outcomes.

The performance of students in Biology in a public examination conducted by the West African Examinations Council (WAEC) is usually not systematic as shown in the WAEC results from 2016 – 2020. The performance of students ranges between 40.3 – 52.6%. These inconsistencies can be linked to the learning strategies of the students (Chief Examiner's Report of WAEC 2016 - 2020). The inconsistencies in the performance of students motivate this study. Learning is a process of acquiring new or modified knowledge, behaviour, skills, values, or preferences.

The audio-visual classroom using a projector is one of the digital technologies in education for encouraging students to participate in active learning. An audio-visual

classroom is an innovative approach to teaching and learning in which students watch a video lesson or recorded lectures outside of class while participating in hands-on activities. The audio-visual classroom using a projector allows the students to have a learning experience when the teacher guides them through the material. By using an audio-visual innovational classroom approach in teaching and learning practices, the teacher can prepare lesson videos, and students can watch them outside class. The audio-visual classroom allows students to watch the videos at their leisure and study at their own pace. Similar to the audio-visual classroom digital device (projector) as an innovational approach is the audio innovational approach using mobile phones.

Audio classroom digital device (mobile phone), an innovational approach allows a teacher to present lessons more dynamically by hearing (ear-sense) through listening than simply teaching and writing on the chalkboard. Teachers can focus on the class and interact with the students as they listen instead of writing on the chalkboard because the text and the entire lesson presentation are already in the form of an audio file using the mobile phone. Lengthy materials can readily be summarized and presented. The audio-innovational approach to teaching was created to improve learning by listening and creating more organized and engaging presentations for the audiences (Okoye, 2016). The study used the concept of nutrition to experiment with the effect of digital devices.

Nutrition is the act or process of nourishing or being nourished. It is the sum of the processes by which animals, humans, and plants take in and utilize food substances. It is the process of taking in food and converting it into energy and other vital nutrients required for life, how the body uses them, and the relationship between diet, health, and disease. Nutritional processes include ingestion, digestion, absorption, assimilation, and egestion. The science that studies the physiological process of nutrition is called Nutritional science. Nutrients are found in the variety of food that we eat. We have six classes of food from which we get all nutrients. Modes of Nutrition are autotrophic, a type of nutrition in which the plants and other photosynthetic organisms prepare their food with the help of sunlight, water, and carbon dioxide, and heterotrophic in which the animals cannot prepare their food. They have to rely on other animals for nutrition.

Food can be classified as Carbohydrates, Protein, Fat and oil, Vitamins, Minerals, and Water. Carbohydrates are energy-giving foods like sugars or starches. Examples are yams, bananas, cassava, bread, sweet potatoes, maize, and rice). Protein is a complex organic compound made of amino acids that makes us grow, strengthen, and repair the body. Examples are beans, fish, cow milk, pork, and egg. Fat and oil establish as fatty acids and glycerol give us energy for work and play. They keep us warm. Examples are palm oil, soy oil, margarine, groundnut, avocado, olive oil, sardines, and vegetable oil. Vitamins protect us from diseases. Examples are fruits like pawpaw, orange, pineapple, and mango. Minerals help to form strong bones and teeth. Examples are milk, meat, vegetables, fruits, grains, beans, and starchy vegetables. Water carries nutrients to all parts of the body and helps to remove wastes from the body.

According to Nzewi (2012), there is an acknowledged problem of female

underachievement if compared to their male counterparts, apparently under equivalent conditions. This problem of female underachievement appears to be more pronounced in science and mathematics. Gender is, in essence, a term used to emphasize that sex inequality is not caused by the anatomic and physiological differences that characterize men and women but rather by the unequal and inequitable treatment socially accorded to them (Nworgu, 2016). Biology plays a vital role in the health sector and for technological development and is one of the basic core subjects taught in Nigerian secondary schools; everybody should have the same opportunity to learn and achieve in biology. The use of digital devices as an innovational approach in Biology teaching may have gender (male and female students) based implications which is worth exploring as the moderating variable for the study.

This study, therefore, investigates the effect of digital devices as innovation approaches to enhancing academic achievement in Biology (using the concept of nutrition) among secondary school students in Eket Local Government Area, Akwa Ibom State, Nigeria.

Biology is a core subject at the senior secondary school level of education and a prerequisite for gaining admission into biological disciplines in tertiary institutions in Nigeria. The inconsistencies in students' performance in Biology in WASSCE results from 2016 – 2020 motivated this study to test the effect of learning strategies on students' achievement in Biology and gender.

The purpose was to investigate the effect of digital devices on secondary school students' academic achievement in Biology in the Eket Local Government Area. Specifically, the study aims to:

1. Determine the mean achievement scores of students in Biology when taught the concept of nutrition using a projector or mobile phone and those with expository strategy among secondary school students in the Eket Local Government Area.
2. Compare the mean achievement scores of male and female Biology students when taught the concept of nutrition using a projector or mobile phone and those with expository strategy among secondary school students in the Eket Local Government Area.

Hypotheses

The following hypotheses were formulated for the study.

1. There is no significant difference between the mean achievement scores of students in Biology when taught the concept of Nutrition using a projector or mobile phone and those using an expository strategy.
2. There is no significant difference between the mean achievement scores of male and female students in Biology when taught the concept of Nutrition using a projector or mobile phone and those using an expository strategy.

METHOD

This study adopted a quasi-experimental design using a pretest and posttest non-randomized control group design. The study was conducted in Eket Local Government Area of Akwa Ibom State, Nigeria. Eket is a town and Local Government Area in Akwa Ibom State. The population comprised all the Senior Secondary One students who study Biology in the nine public co-educational secondary schools in Eket Local Government Area during the 2021/2022 academic session. They are 18210 students in 2021/2022 (Source: *Local Education Committee, Eket, 2021*). The choice of SS1 students was that the topic forms part of the SS1 scheme of work for Biology.

A sample of 150 students from three schools was selected [50 students in the first group (27 males and 23 females), 47 students in the second group (21 males and 26 females), and 53 students in the third group (24 males and 29 females)]. A criterion sampling technique was used to select the sample. Five schools met the criteria; three were then randomly selected and assigned to experimental conditions. Students in the three schools were in their classes. The choice of co-education schools is because gender is one of the variables under study.

The researchers made an instrument titled Biology Achievement Test (BAT) used for data collection in this study. BAT consists of two sections; sections A and B. Section A consists of information on demographic variables such as gender. Section B consists of 20 multiple choice questions lettered A-D with only one correct option and three distracters. The Biology Achievement Test (BAT) was subjected to content and face validations. This was done by a panel of two experts; one biology lecturer and one measurement and evaluation lecturer in the Department of Science Education, Akwa Ibom State University, Mkpato Enin. The validity verdict from the two validators was incorporated into the final production of the instrument.

The instrument was administered to 20 students drawn from one school in the area of the study that did not form part of the study after two weeks; the same test was re-administered but was reshuffled which is a test-retest method of assessing the stability of the instrument and KR20 reliability method was used to compare the internal consistency, and a reliability coefficient was determined at 0.78 indicating high-reliability index which made the instrument suitable for use in the study. Data were analyzed using mean and standard deviation. Analysis of Covariance (ANCOVA) tests all the hypotheses at a 0.05 alpha level of significance.

RESULTS

Table 1: Mean and Standard Deviation of Pre-test and Post-test Academic Achievement Scores of Students taught nutrition Classified by Instructional Approaches

Instructional Approaches	Pre-test			Post-test		Mean Difference
	N	\bar{X}	SD	\bar{X}	SD	
Projector	53	14.49	3.94	62.66	11.12	48.17
Mobile Phone	47	13.34	4.84	64.40	10.23	51.06
Expository Strategy	50	7.28	3.55	47.26	6.62	39.98

Table 1 shows that the mean pre-test scores of students taught the concept of nutrition using a projector, mobile phone, and expository strategy are 14.49, 13.34, and 7.28, respectively; standard deviation scores of 3.94, 4.84, and 3.55, respectively, while their respective mean post-test scores are 62.66, 64.40 and 47.26 with standard deviation scores as 11.12, 10.23 and 6.62 respectively. It indicates that the mean achievement scores of the three groups (projector, mobile phone, and expository strategy) increased from pre-test to post-test. The table also shows the mean difference scores of students taught the concept of nutrition using a projector, mobile phone, and expository strategy as 48.17, 51.06, and 39.98, respectively. Comparing the mean difference scores of the three groups, it indicates that mobile phone was the highest in enhancing students' academic achievement with a mean difference score of 51.06, followed by a projector with a mean difference score of 44.12 and expository strategy was the least with the mean difference of 39.98.

Table 2: Mean and Standard Deviation of Male and Female Biology Students' Pre-test and Post-test Scores Taught Nutrition Classified by Digital Devices

Digital Devices	Gender	N	Pretest		Posttest		Mean Difference
			\bar{X}	SD	\bar{X}	SD	
Projector	Male	25	14.68	4.02	59.40	10.04	44.72
	Female	28	14.32	3.93	65.57	11.38	51.25
Mobile Phone	Male	25	12.96	4.01	62.84	9.85	49.88
	Female	22	13.77	5.71	66.18	10.60	52.41
Expository Strategy	Male	28	8.27	3.85	46.91	7.98	38.64
	Female	22	6.50	3.13	47.53	5.46	33.77

In Table 2, the results show that the mean difference achievement score of male students taught nutrition using a projector is 44.72, and their female counterparts' mean is 51.25. The mean difference achievement score of male students taught nutrition using mobile phones is 49.88 and their female counterparts are 52.41. The table also showed that the mean difference achievement score of male students who studied nutrition using expository strategy is 38.64,

and their female counterparts' mean is 33.77. From the results, female students achieved higher than their male counterparts when taught nutrition using a projector and mobile phone. Male students achieved higher than their female counterparts who studied nutrition using an expository strategy.

Table 3: Analysis of Covariance (ANCOVA) of Students' Post-test Scores Classified by Instructional Approach with Pre-test Scores as Covariate

Source	Sum of Squares	Df	Mean Square	F- Value	P- Value
Corrected Model	10311.801 ^a	6	1718.633	20.600	.000
Intercept	41716.015	1	41716.015	500.016	.000
Covariate (Pretest)	827.880	1	827.880	9.923	.061
Main Effect (Devices)	3498.400	2	1749.200	20.966	.000
Main Effect (Gender)	235.980	1	235.980	2.829	.095
Devices * Gender	407.909	2	203.954	2.445	.090
Total	528119.000	150			

^{NS} = Not significant at .05 level of significance; * = Significant at .05 level of significance

Results in Table 3 show that the analysis of covariate (pre-test scores) of the three groups of students taught nutrition using a projector, mobile phone, and expository strategy is not significant since the calculated F-value (9.92) has a calculated p-value (.06) is greater than the significant level (.05), indicating that the mean of the three groups was statistically equivalent. The table also shows that the calculated F-value (20.97) and a calculated p-value (.00) of the main effects of devices are less than the significant level (.05). Therefore, the hypothesis that there is no significant difference between the mean achievement scores of students in Biology when taught the concept of nutrition using a projector, mobile phone and those using expository strategy is rejected. It signifies a significant difference among the academic achievement mean scores of Biology students taught nutrition using a projector, mobile phone, and expository strategy. To determine the direction of significance, the scores were subjected to post hoc analysis (Table 3).

Table 3 further shows the main effects of gender as the calculated F-value (20.96) is greater than a calculated p-value (.09) at the significant level (.05). Therefore, the null hypothesis that there is no significant difference between the mean achievement scores of male and female students in Biology when taught the concept of nutrition using a projector, mobile phone and those using expository strategy is accepted. It implies that there is no significant difference between the academic achievements means scores of male and female Biology students taught nutrition using a projector, mobile phone, and expository strategy.

Discussion of Findings

The finding revealed a significant relationship between students taught using digital devices and those using an expository strategy for learning Biology. Students taught nutrition using a projector and mobile phone significantly achieved more when compared with those using an expository strategy. A non-significant difference exists between the achievement scores of Biology students taught using a projector and mobile phone. The implementation of digital devices as alternative teaching tools increased students' productivity more than the expository strategy. Digital devices can give students more time to think, allow for multiple representations, and provide opportunities (especially for slow learners) to catch up with others. When students are stuck on a problem, they can write out their thought processes and may be able to see their errors and solve the problem. The finding supports the work of Obodo, Animercy & Okolo (2019), who found that students who used digital technology as an innovational approach achieved better in basic science than their counterparts who used the conventional method. Digital technology group students were superior in achievement test scores because they were given time to bring the learning process to their senses, seeing, hearing, and touching.

The finding of this study agrees with Adedapo, Salawu and Afolabi (2011), who assessed the effects of Videotaped (VT) and audio-taped instructions on cognitive outcomes in Economics. The result showed a significant difference in the student's cognitive achievement and interest in Economics which were mostly enhanced by the VT strategy, followed by the audio tape strategy, and minimally by the conventional strategy. The finding also agrees with Lalitha and Shailaja (2016), who conducted a study on the effects of digital technology on traditional teaching methods. The findings indicated that digital technologies have an impact on the teaching and learning of basic science. Hence, digital technology was more effective than traditional teaching in imparting knowledge but not developing understanding.

The analysis of the mean academic achievement of students based on gender shows no significant difference in the mean achievement of male and female students taught nutrition with a projector, mobile phone, and expository strategy. Also, there was no significant difference between the retention mean scores of male and female Biology students taught using nutrition using a projector, mobile phone, and expository strategy. Although females had slightly higher posttest mean achievement and retention scores than males, the corresponding hypothesis shows no significant difference between the mean achievement scores of male and female students in biology.

Based on the decision rule, the null hypothesis that there was no significant difference in the mean achievement of male and female Biology students taught using nutrition using a projector, mobile phone, and expository strategy is upheld. Nwona (2014) noted the imbalance against women in science, technology, and mathematics, which were perceived as masculine subjects. The study has demonstrated that different teaching strategies produced different results. The identification of the best teaching strategy for a given set of

students must be done if the best result must be achieved. The result of this study has been able to bridge the gap in the achievement of male and female students in favour of females. The finding aligns with Ajitoni's (2007), who found a significant difference between male and female students' attitude in favour of females. Aremu and Sangodoyin (2010) conducted a study on the effect of digital technology on the academic achievement of Nigerian senior secondary school students in Biology. Their results showed no significant effect of gender on students' academic achievement in Biology.

Conclusion and Recommendations

Mobile phones in an audio lesson and projectors in an audio-visual lesson promote students' achievement in Biology. Female students significantly achieved more than male students in studying food and nutrition. Biology teachers have to understand these learning strategies to maximize students' achievement. In order not to disadvantage male students in the class, it is pertinent that other learning strategies that will make male students achieve at maximum should be explored. Based on the results, the recommendations are:

1. Due to the effectiveness of digital devices learning strategy over the expository learning strategy on students' achievement, it is recommended for use by the students in the learning of Biology, especially, for abstract topics.
2. Curriculum planners should review the Biology curriculum to include digital devices application while teaching to ignite students' interest in learning.

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