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Effect of Improvised Aquarium on Academic Achievement in Biology among Senior Secondary School Students in Abak Local Government Area of Akwa Ibom State

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ABSTRACT

A quasi-experimental study was conducted in Abak Local Government Area of Akwa Ibom State. The aim was to examine the effect of improvised aquarium on senior secondary school students' achievement. The non-randomized pre-test post-test control group design was adopted. The instrument for data was "Biology Achievement Tests" (BATs). The instrument was face and content validated by three experts from the Akwa Ibom State University. The reliability of the instrument using Kuder-Richardson formula-20 (K-R 20) was 0.83. The instrument was administered on one hundred and seventy-eight senior secondary one (SS1) Biology students selected through stratified random sampling technique from four of 11 public secondary schools in the area. Two schools were randomly assigned to improvised aquarium treatment group and two to stream treatment group. The data were analysed using mean and standard deviation, while hypotheses were tested at a 0.05 level of significance using ANCOVA. Findings encompassed that with the use of improvised aquarium, students' achievement was better than those taught without. Consequently, improvised aquarium facilitated students' academic achievement in Biology.

Keywords: Improvised Aquarium, Academic Achievement, Biology and Aquatic habitat.

INTRODUCTION

Biology as one of the science subjects is coined from two Greek words: Bio, which means life and Logos, meaning study (Hills *et al*., 2020). They maintained that Biology is the scientific study of life. It is a natural science with a broad scope but has several unifying themes that tie it together as a single, coherent field, which helped Biologist to study life at multiple level of organisation, from the molecular biology of a cell to the anatomy and physiology of plants, animals and evolution of population. Biology curriculum was adapted and revised by the Nigeria Educational Research and Development Council (NERDC) from

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the Comparative Education Study and Adaptation Centre (CESAC) of 1985 for used in the secondary schools to ensure continuity and flow of themes, topics and experiences from senior secondary one to three levels of the Federal Ministry of Education (FME, 2013).

Despite the direction of the Biology curriculum which aimed at improving the quality of education through effective teaching, learning, management, administration and counselling and engaging the policy preparation for leveraging the limitless possibilities of education in promoting the development of work related skills, life-long learning and a meaningful understanding of concepts, students' achievements in the subject has never been encouraging over the years (WAEC Chief Examiners Report, 2018-2022). According to the WAEC Chief Examiner's Report, students' achievement in Biology in the West African Senior School Certificate Examination (WASSCE) in 2019 was worse than the year 2018 with a raw mean score of 26 and standard deviation of 9.00 compared to a raw mean score of 32 and standard deviation of 10.86 for the WASSCE in 2018 where a total number of candidates that sat for the examination was 74,379 (WAEC, 2018-2019).

In 2021 and 2022, the Chief Examiner report indicated that the achievement of candidates in the year 2021 was slightly better than that of the year 2022 with a raw mean score of 31 and standard deviation of 9.41 when compared with the raw mean score and a standard deviation obtained from previous years of WASSCE for school candidate (WAEC, 2021 and 2022). From the Reports, none of the four years' WASSCE results recorded an average of 70% pass in Biology. The observed poor achievement in Biology examinations is not different from WASSCE record of Akwa Ibom State and Abak Local Government Area in particular that took the same examination. It leaves one in doubt about the effectiveness of instructional materials and teaching methods used by the teachers for the teaching and learning of Biology (Chief Examiners Report, 2018-2022). Braimoh and Okadeyi (2021) also indicated that students poor achievement in Biology could be attributed to many factors not limiting to non-utilization and availability of instructional material, syllabus, teacher's qualifications, workload, experience and disposition, general lack of teaching skills and teachers' method of instruction delivery, lack of motivation for teachers, poor infrastructural facilities and competence by science teachers and lack of opportunities for professional development of science teachers.

According to Idoko and Njoku (2017), poor laboratory facilities, students' attitude to learning, time factor, class size, inadequate facilities, characteristics of teachers and ineffective teaching materials contributed to students' poor achievement in Biology. The authors at different points observed that most Nigerian secondary schools are used to the conventional method of teaching Biology and other related science subject. As a result, students' activities during classes are limited to passive listening, receptive learning and rote

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memorization. Although in the National Policy on Education (FME, 2016), emphasis has been placed on teaching methods like field studies, guided discovery, laboratory techniques and skills along with conceptual attitude that will meet the needs of the learner and society through relevance and functionality in its contents, methods, processes and applications, yet, teachers' failure to consider these factors risk the effectiveness of implementing the Biology curriculum in schools,

Ugwu *et al.* (2020) emphasized that for Biology to fulfil the need for academic achievements of students, the teacher must select the best instructional materials to present to students; try out improvisation, new methods, and strategies and utilize one-on-one instruction. With these views, Biology should be taught utilizing a variety of instructional materials since it requires hands-on activities as a science subject. Aside, the government may not have all the materials to effectively provide the needs of all the schools, and the knowledge that no country has all of the necessary teaching and learning materials in its educational institutions and the variations of the materials for a subject lead to improvisation (Adamu, 2021). Alonge (2018) states that improvisation means taking the place of something that is not available; when the actual piece of materials is unavailable, some people consider it to be the use of substitutes. According to Atadoga *et al.* (2022), improvisation is using locally produced instructional materials made from readily available natural materials to replace the conventional materials that are not available or to make up for inadequate materials that are available. Lukeman (2021) argues that improvisation is the practice of producing and using local materials in the absence of real ones in teaching and learning situations; it means making local provision of instructional materials to impact adequate and relevant knowledge, skills, facts and values to the learner for the achievement of better understanding during teaching and learning instruction.

Abolade (2014) reported that some of the factory made or imported instructional materials have been discovered to be based on foreign ideas, culture and acknowledged the need to locally produce them to grant the learners a first-hand experience during teaching and learning process, reduce the burden of talking too much on the part of the teachers; create a clearer picture of the concept taught; make the lesson interesting and less difficult for the learner to understand; assist the teacher economically; allow students interaction and make students use their intellectual ability during learning and teaching process. According to Atadoga and Onalapo (2018), there are two approaches to improvisation; one focuses on the teaching methods and the other on the materials. However, the two approaches are summed up by the need for improvisation such as means of minimizing costs of material, challenge to intellectual curiosity and productive application, means of putting sciences to use locally, cost-effective approach to expanding the scope of inquiry, acquiring the necessary scientific,

methodological, emotional, and practical abilities to function effectively in society as professional scientists, give teachers the opportunity to consider and conduct research faster, less expensive, and easier approaches to facilitating students' learning through instruction; as a result, encourage self-reliance and creativity, create a mental bridge that takes students from mental indigestion or abstraction to a nodding acquaintance with reality (Atadoga and Onalapo 2018). Dewey (1968) indicated that experience is the source of all knowledge and emphasized the importance of practical activities in science lessons at all levels of education.

Aquatic habitat relates to lives in water; organisms that live in water are called aquatic organisms (Helm, 2021). Examples of aquatic organisms are fish, crabs, toads, plants. Improvised aquarium may be Marine or fresh water in a classroom setting, as an alternative to streams, ponds, lakes and rivers is a better fit instructional material that may allow students a more hands-on approach to this aquatic habitat topic in Biology. Jeanne and Gosse (2021) explained that an aquarium is receptacle for maintaining aquatic organisms, either freshwater or marine, or a facility in which a collection of aquatic organisms is displayed or studied. Biology teachers are improvising aquarium when they try to alter an existing material to fulfill the same purpose or create completely a new piece of material out of materials that are readily available in their schools. With the application of hand on activity, Ibe and Abamuche (2019) agreed the use of hands-on instructional material will help improve, enrich and make learning more meaningful, as students can manage their learning and apply them in their independent study. Ibitoye and Fape (2017) opined that good teachers should organise classroom activities that are interesting to learners and appropriate for their developmental level so that they can use their brain to construct their knowledge and understanding by interacting with the environment around them to improve their academic achievement in Biology.

Academic achievement is an extent a student, teacher or institution has attained their short or long-term educational goals (Ward, Howard & Mildred, 2016). Academic achievement is commonly measured through examinations or continuous assessments; but there is no general agreement on how it is best evaluated or which aspects are most important. Teachers should expose students to the rudiments of practical activities that will enable them to understand and assimilate some of the biological concepts, terms and theories (Adetayo 2018). It will also help students to learn with interest and the wish to continue in the future. Hassan (2016) pointed out that effective learning and sound academic achievement contribute to national development, prepare students for future careers, allow students to enter competitive fields and often a sign of a refined intellect, which help students in all areas of their lives. Stumm *et al*. (2021) claim that one of the purposes of testing the achievement

level of students is to help teachers and students evaluate and estimate the degree of success attained in learning a given concept.

The current decline in academic achievement of students in Biology (WAEC Chief Examiner 2019-2022) raises concerns about their educational, scientific, and technological progress. The effectiveness of instructional materials used in science lessons determines their relevance, suitability, and application to students' academic attainment. Although effective teaching techniques are critical determinant of students' academic achievement in Biology, but factors such as inadequate supply of instructional materials, financial constraints, lack of skills, and ineffective strategies hinder their use. Despite the lack of evidence linking teachers' failure to improvise instructional materials to Biology instruction with the decline in students' academic achievement in Biology, it is still a concern that needs further research. The aim of this study is to investigate the effect of improvised aquarium on academic achievement in Biology among senior secondary school students in Abak Local Government Area of Akwa Ibom State.

Research Hypotheses

Null hypotheses were formulated and tested at a 0.05 alpha level of significance.

1. There is no significant difference in the mean achievement scores of students taught aquatic habitat using improvised aquarium and those taught without in senior secondary school in Abak Local Government Area of Akwa Ibom State.
2. There is no significant difference in the mean achievement scores of male and female students taught aquatic habitat using improvised aquarium in senior secondary school in Abak Local Government Area of Akwa Ibom State.
3. There is no significant difference in the mean achievement scores of urban and rural students taught aquatic habitat using improvised aquarium in senior secondary school in Abak Local Government Area of Akwa Ibom State.

METHOD

A quasi-experimental design was used for the study. The pre-test and post-test non-equivalent control-group design was adopted. The study was carried out in Abak Local Government Area in Akwa Ibom State, Nigeria. The population consisted of all the 1,785 Senior Secondary One (SS1) Biology students for the 2022/2023 academic year in the 11 public secondary schools in Abak Local Government Area of Akwa Ibom State (Data obtained from Local Education Committee, Abak, 2023). A sample of one hundred and seventy-eight (178) SS1 Biology students, selected from six public secondary schools (urban and rural) using

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stratified random sampling technique. Students in the six schools were similarly assigned to intact classes of the experimental and control groups. Treatment was randomly assigned to each intact class of improvised aquarium and those taught without.

A Biology Achievement Test (BAT) was developed by the researcher and validated by expert in Biology Education, expert in Measurement and Evaluation from the Akwa Ibom State University and two Biology teachers for content validity. The reliability of the instrument using Kuder-Richardson Formula 20 (KR20) yielded a reliability index of 0.88. Fifty (50) multiple choice BAT questions were administered to a trial group of sixty (60) students in a school of comparable status in Abak Local Government Area, which was not selected for the main study. The BAT has one correct answer and three distracters for each of the 50 questions. Each correctly answered question was scored one (1) mark and incorrect answers scored zero. Hence, the maximum and minimum scores were fifty and zero respectively. The experimental group were taught using improvised aquarium, while the control group were those taught without. Mean and standard deviation were used to analyse data, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at a 0.05 level of significance.

RESULTS

Table 1: Mean achievement scores of students taught aquatic habitat using improvised aquarium and those taught without

Group	Group statistics	Pretest	Posttest	Mean gain	Mean difference
Improvised aquarium	N	79	79		
	Mean	22.43	36.90	14.47	
	SD	3.45	6.91		12.45
Taught without	N	99	99		
	Mean	19.17	21.19	2.02	
	SD	3.02	3.61		

The mean gain score of students that were taught aquatic habitat with the use of improvised aquarium was 14.47, while the students taught without have a mean gain score of 2.02 (Table 1). The table also shows a mean difference of 12.45 between the two groups. The result suggests that improvised aquarium enhanced the achievement of students in aquatic habitat than those taught without.

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Table 2: Analysis of covariance of the achievement scores of students taught aquatic habitat using improvised aquarium and those taught without

Sources of variation	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	11128.177[a]	2	5564.089	179.922	.000
Intercept	2061.750	1	2061.750	66.669	.000
Pretest	285.268	1	285.268	9.225	.003
Teaching strategy	10868.267	1	10868.267	351.440	.000
Error	5411.874	175	30.925		
Total	175961.000	178			
Corrected Total	16540.051	177			

*significant at p ≤ .05 alpha, n = 178

Table 2 reveals that there was a statistically significant difference in the mean achievement scores of students taught aquatic habitat using improvised aquarium and those taught without, $F(1,177) = 351.440$, $p < .05$. Hence, the hypothesis one that there is no significant difference in the mean achievement scores of students taught aquatic habitat using improvised aquarium and those taught without was rejected. It implies that there is a significant difference in the mean achievement scores of students taught aquatic habitat using improvised aquarium and those taught without. With the application of relevant instructional aid like aquarium, students' achievement was improved. This finding agrees with that of Ibe and Abamuche (2019) that the use of appropriate instructional materials improved students' academic achievement.

Table 3: Analysis of covariance of the achievement scores of male and female students taught aquatic habitat using improvised aquarium

Sources of variation	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	266.574[a]	2	133.287	1.433	.241
Intercept	2269.471	1	2269.471	24.405	.000
Pretest	264.635	1	264.635	2.846	.093
Gender	6.664	1	6.664	.072	.789
Error	16273.477	175	92.991		
Total	175961.000	178			
Corrected Total	16540.051	177			

*Not significant at p ≥ .05 alpha, n = 178

Table 3 reveals that there was no statistically significant difference in the mean achievement scores of male and female students taught aquatic habitat using improvised aquarium, $F(1,177) = .072$, $p > .05$. Hence, the hypothesis that there is no significant difference in the mean achievement scores of male and female students taught aquatic habitat using improvised aquarium was accepted. It implies that there is no significant difference in the

mean achievement scores of male and female students taught aquatic habitat using improvised aquarium.

Table 4: Analysis of covariance of the achievement scores of urban and rural students taught aquatic habitat using improvised aquarium

Sources of variation	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1388.225[a]	2	694.112	8.017	.000
Intercept	2326.207	1	2326.207	26.867	.000
Pretest	276.706	1	276.706	3.196	.076
School location	1128.315	1	1128.315	13.032	.000
Error	15151.826	175	86.582		
Total	175961.000	178			
Corrected Total	16540.051	177			

*significant ≤ .05 alpha, n = 178

Table 4 reveals that there was a statistically significant difference in the mean achievement scores of urban and rural students taught aquatic habitat using improvised aquarium, $F(1,177) = 13.032$, $p < .05$. Hence, hypothesis that there is no significant difference in the mean achievement scores of urban and rural students taught aquatic habitat using improvised aquarium was rejected. It implies that there is a significant difference in the mean achievement scores of urban and rural students taught aquatic habitat using improvised aquarium.

CONCLUSION

This study assessed the effect of improvised aquarium on academic achievement in Biology among senior secondary school students in Abak Local Government Area of Akwa Ibom State. The findings revealed that students taught aquatic habitat using improvised aquarium achieved significantly better than students taught without. The study concluded that improvised aquarium is an effective strategy that could be employed by teachers for teaching aquatic habitat. Hence, improvised aquarium should be utilised by teachers and students to enhance effective teaching and learning of aquatic habitat since it is a potent tool that can easily bring about conceptual change among the learners.

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