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PROF. PATRICK C. IGBOJINWAEKWU

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EDITORIAL

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Prof. Patrick C. Igbojinwaekwu
Editor-in-Chief

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EFFECTS OF IMPROVISED AND STANDARD INSTRUCTIONAL MATERIALS ON ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN BIOLOGY

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Abstract

This study explored how improvised and standard instructional materials impact secondary students' achievement in Biology. The study was guided by three research questions and three hypotheses. The research adopted a quasi-experimental design within Enugu Education Zone, Enugu State. The population comprised 4,737 Senior Secondary II students across 33 schools. A sample of 316 students from six co-educational schools was randomly selected, with equal gender representation. The students were divided into three groups; one taught with improvised materials, another with standard instructional materials, and a control group using traditional methods, determined through balloting without replacement. The researcher developed the Biology Achievement Test (BAT) to measure students' pre-test and post-test scores over six weeks. Data analysis involved mean, standard deviation, and ANCOVA at a 0.05 significance level. Results revealed a significant difference in achievement scores favoring students taught with either improvised or standard materials compared to conventional methods. No significant gender differences were found in achievement scores indicating that gender did not influence performance when using either instructional approach. The findings imply that utilizing instructional materials whether improvised or standard can enhance students' understanding and achievement in Biology. The study recommends that Biology teachers incorporate such materials in their teaching to improve learning outcomes, emphasizing their proven effectiveness. From the recommendations conclusions were drowned.

Keywords: Improvised and Standard Instructional Materials, academic achievement

Introduction

Biology is essential for admission into Nigerian universities' science courses like Medicine, Pharmacy, and Biochemistry. It studies living organisms, their structures, functions, evolution, and interrelationships. Enebechi (2021) describes it as the science of life, covering processes like movement, respiration, growth, and reproduction, vital for scientific research, environmental exploration, and improving quality of life. Despite its importance, secondary school students often perform poorly in Biology, showing low academic achievement scores and weaknesses in subject just as reported by two examination bodies, West African Examination Council (WAEC) and National Examination Council (NECO).

The Chief Examiners' Reports from 2018-2022 for Nigeria's WAEC and NECO examinations reveal that secondary students' average scores in Biology have consistently been below 50%, indicating poor academic achievement. The reports highlight weaknesses in understanding key concepts, especially in ecology, genetics, and cell biology, due to poor grasp of terminology, diagramming, and application skills. Other common weaknesses include inability to identify ecological instruments, improper diagram labelling, and lack of understanding of biological systems. These shortcomings raise concern among educators, as Biology is fundamental to understanding the environment and life processes. The core causes of these weaknesses remain a critical question for stakeholders. But one may decide to question, what could be the causes of these weaknesses that led to poor achievement in some of these Biology concepts?

Literature has indicated the causes of the weaknesses leading to poor achievement in Biology concepts could be closely related to the type and quality of instructional materials used in teaching some Biology concepts. According to Okolocha and Nwaukwa (2020), low test scores reflect inadequate demonstration of knowledge, which can be worsened when instructional materials fail to effectively engage students or make abstract concepts tangible. Sabina, Markprince and Eric (2022) emphasize that instructional materials are crucial for stimulating retention and understanding, which are vital for academic success. That is to say that in resource-constrained environments, teachers often rely on improvised materials due to economic challenges like high inflation and import costs. While improvised materials are accessible and relevant, their effectiveness depends on proper design and implementation. Poorly prepared or inadequate improvised aids can fail to foster deep understanding, thus contributing to

weaknesses in grasping complex concepts like ecology and genetics. Conversely, standard materials, when available, tend to provide consistent quality, aiding better retention and comprehension, as noted by Adonu Nwagbo, Ugwanyi and Okeke, (2021).

However, the debate surrounding efficacy whether from standard, improvised, or no instructional materials relates directly to these weaknesses. Some studies suggest that, when well-made, improvised aids can outperform standard resources, especially in contexts where imported materials are unavailable. However, in cases where improvised aids are poorly designed or insufficient, students may develop shallow understanding, leading to low achievement.

Furthermore, the lack of inadequacy of appropriate instructional materials can lead to rote learning, reduced engagement, and inability to connect concepts meaningfully, all of which impede retention and knowledge transfer. This directly impacts students' ability to perform well in assessments, deepening the achievement gap (Adonu et al., 2021). This could be the reason while Yetunde (2020) reported a no significant difference in pre-test and post test scores between male and female students taught with improvised instructional materials, a significant difference between pre Biology and post Biology skill of students taught with improvised materials and lecture method in Lagos State.

More so, Ibe, Obkezie and Chekendu, (2021), Anyakorah (2021) and Nuhu Abba, Musa, Grace and Maryam (2021) revealed separately that student taught Biology in the treatment group using improvised instructional material achieved better than those taught in the control group with no instructional material using Problem-solving Skill Theory (PSST) and Triarchic theory of intelligence, which emphasize on active problem-solving and multisensory learning in Anambra, Imo and Kaduna respectively. Engaging multiple senses fosters better understanding, making these instructional approaches highly effective for improving student achievement. However, Mike, Eduardo, Peter, Zach, Rolf and Joel (2019) observed that students taught science with standard instructional material performed better than their counterpart taught with no instructional material in Northern Asia.

Furthermore, Ezeliora, Ibe and Obikezie, (2021) whom in their different studies and fields observed a significant difference in the mean achievement scores of students taught with standardized and improvised instructional materials and those exposed to

no instructional material in favour of students taught with standardized and improvised instructional materials in Awka Education Zone of Anambra State. But Yetunde (2020) observed that gender effect was not statistically significant in social studies using standard instructional material using Jerome Bruner's Discovery Learning Theory in Mathematics, which emphasizes problem-solving and internal reorganization to foster understanding. Additionally, Hussaini, Tijjani and Yahaya (2022) reported no significant difference among the sexes in optical concept in Asia. While some group of researchers observed that higher achievement mean score of male students seemed to lend support to the assertion of some scholars who argued that males achieve higher than females in Chemistry subject (Ibe, 2017 & Mike, et. al. 2019).

Hussaini, et al (2022) observed no significant difference among the sexes in optical concept. While Abubakar, and Dembo (2018) did a single sex study and found a significant difference between the mean performances of female student taught in basic science concepts using real materials with lecture method compared to those taught with improvised materials while Abanikannda (2021) who opined that there is no significant difference between male and female students in the impact of improvisation of learning resources on Biology instruction. But Williams and Otoyo (2021) buttressed a significant difference between the mean achievement scores of students by gender. It is therefore the case that the improvised instructional material is favourable in improving achievement of the both gender categories.

From the forgoing, it can be observed that both standard and improvised instructional materials has been widely used in so many subject and in many areas but the study of teaching without instructional material in most science subject seems to be rare. Also the issue of gender seems inconclusive, especially as regards to secondary school students in Enugu State, Nigeria. This gap is what this study filled. Thus, this study focused on effect of improvised and standard instructional materials on academic achievement of secondary school students in Biology.

Purpose of the Study

The main purpose of this study is to investigate the effect of improvised and standard instructional materials on academic achievement of secondary school students in Biology. Specifically, the study seeks to examine the;

1. effect of standardized and improvised instructional materials on the achievement mean scores of secondary school students in Biology.
2. achievement mean scores of male and female students taught Biology using standardized instructional materials.
3. achievement mean scores of male and female students taught Biology using improvised instructional materials.

Research questions

The study was guided by the following research questions;

1. What is the effect of standardized and improvised instructional materials on the mean achievement scores of secondary school students in Biology?
2. What is the mean achievement scores of male and female students taught Biology using standardized instructional materials?
3. What is the mean achievement scores of male and female students taught Biology using improvised instructional materials?

Hypotheses

The study tested the following null hypothesis at .05 level of significance.

1. There is no significant difference in the mean achievement scores of students taught Biology using instructional materials (standardized and improvised instructional) and those taught without materials.
2. There is no significant difference in the mean achievement scores of male and female students taught Biology using standardized instructional materials.
3. There is no significant difference in the mean achievement scores of male and female students taught Biology using improvised instructional materials.

Methodology

The design of the study was quasi-experimental design. The area of the study was Enugu Education Zone of Enugu state, Nigeria. Enugu Education Zone is in Enugu Central Senatorial District of Enugu state. The population of the study comprised all the senior secondary (SS II) Biology students in the (twenty one) 21 public co-educational secondary school in Enugu Education Zone of Enugu State. The sample consisted of six schools, comprising all the 316 SS2 Biology students (159 males and

157 females). These were used in their intact classes. The six schools were drawn from the 17 co-educational secondary schools with the needed standard materials in the zone. The sample was obtained using simple random sampling to pick out six co-educational schools.

Secondly, using random allotment, two coeducational schools were assigned to each of the three independent variables used for the study (IIM, SIM and WIM). Two co-educational schools were taught using standard instructional materials (SIM), two were taught using improvised instructional materials (IIM), and the remaining two were taught without instructional materials (WIM).

Instrument

The instrument for data collection was the researcher-developed Biology Achievement Test (BAT). The BAT has thirty (30) multiple-choice objective questions covering Biology concepts of ecology. The questions have options lettered A-D for students to choose the correct option. The BAT is divided into two sections; section A- designed to determine the demographic information of the students and section B contained the objective questions. BAT was used for achievement tests.

To ascertain the validity of the instrument, the researcher subjected the test (BAT) to face validation. Two lecturers from the Department of Science Education Enugu State University of Science and Technology (ESUT) and one lecturers from the Department of Measurement and Evaluation Ebonyi State University Abakaliki. These experts were given the research topic, purpose of study, research questions, hypotheses and validate. Their inputs were used in the 30-item instrument. The validators are also content-validated (BAT). The test was developed based on a test blueprint developed by the researcher on Bloom's Taxonomy of educational objectives representing low-order and higher-order questions.

The reliability of the instrument was established by administering BAT to thirty (30) students in Agbani Education Zone of Enugu State which is outside the study zone. The data collected were analysed using the Kuder-Richardson formula 20 (KR-20). The coefficient was found to be 0.77 for BAT. These value show that the instrument was reliable for the study. The scores obtained from the pre-test and post-test were analysed using mean, standard deviation and Analysis of Covariance (ANCOVA).

Results

Research Question 1: What is the effect of standardized and improvised instructional materials on the mean achievement scores of secondary school students in Biology?

Table 1: Mean and Standard Deviation of Achievement Scores of Treatments and Control Groups.

Group	N	Adjusted Mean	Standard Deviation
Standardised Instructional Materials	102	77.48	10.11
Improvised Instructional Materials	110	78.14	9.63
No Instructional Materials	104	50.06	9.67

The summary of the result in Table 1 above shows that the standardised instructional materials yielded a mean score of 77.48 with a standard deviation of 10.11, the improvised instructional materials yielded a mean score of 78.14 with a standard deviation of 9.63, while the non-use of instructional materials produced a mean score of 50.06 with a standard deviation of 9.67. This implies that the improvised instructional materials is superior (as it resulted in higher mean scores) to the standardised instructional materials and the non-use of instructional materials in facilitating students' achievement in Biology.

Research Question 2: What is the mean achievement scores of male and female students taught Biology using standardized instructional materials?

Table 2: Mean and Standard Deviation of Achievement Scores of Male and Female Students of the Standardized Instructional Materials Group.

Group	N	Adjusted Mean	Standard Deviation
Male Students	56	79.18	9.15
Female Students	46	75.41	10.92

The summary of the result in Table 2 shows that male students taught Biology using the standardized instructional materials had a mean achievement score of 79.18 with a standard deviation score of 9.15 while their female colleagues taught with the same materials had a mean achievement score of 75.41 with a standard deviation score of

10.92. This shows that male students taught Biology using the standardized instructional materials achieved better than their female counterparts.

Research Question 3: What is the mean achievement scores of male and female students taught Biology using improvised instructional materials?

Table 3: Mean and Standard Deviation of Achievement Scores of Male and Female Students of the Improvised Instructional Materials Group.

Group	N	Adjusted Mean	Standard Deviation
Male Students	54	79.39	9.20
Female Students	56	76.93	9.96

The summary of the result in Table 3 shows that male students taught Biology using the improvised instructional materials had a mean achievement score of 79.39 with a standard deviation score of 9.20 while their female colleagues taught with the same materials had a mean achievement score of 76.93 with a standard deviation score of 9.96. This shows that male students taught Biology using the improvised instructional materials achieved better than their female counterparts.

$H0_1$: There is no significant difference in the mean achievement scores of students taught Biology using standardized and improvised instructional materials and those taught without materials.

Table 4: Analysis of Co-Variance for Students' Overall Biology Achievement Scores by Instructional Materials

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Covariates	19651.009	1	19651.009	887.766	.000
PRETEST	19651.009	1	19651.009	887.766	.000
Main Effects	57379.861	3	19126.620	864.076	.000
METHODS	57192.285	2	28596.143	1291.878	.000
GENDER	1.492	1	1.492	.067	.795
2-Way Interactions	1.666	2	.833	.038	.963
METHODS*GENDER	1.666	2	.833	.038	.963
Explained	77032.536	6	12838.756	580.012	.000
Residual	6839.819	309	22.135		
Total	83872.354	315	266.261		

For hypothesis 1, the summary of the result in the ANCOVA table in Table 4 shows that, for the comparison of the materials of instruction, the P-value (Sig. of F) is 0.00, is less than the alpha (α) level of 0.05. Since the Significance of F value is (0.00) is less than the alpha (α) level (0.05), the null hypothesis was rejected. Therefore, for this hypothesis there is a significant difference in the mean achievement scores of students taught Biology using standardized and improvised instructional materials and those taught without materials in favour of those taught with improvised instructional material was rejected.

$H0_2$: There is no significant difference in the mean achievement scores of male and female students taught Biology using standardized instructional materials.

Table 5: Analysis of Co-Variance for Students' Overall Biology Achievement Scores by Standardised Instructional Materials and by Gender.

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Covariates	9193.484	1	9193.484	804.944	.000
PRETEST	9193.484	1	9193.484	804.944	.000
Main Effects	1.270	1	1.270	.111	.739
GENDER	1.270	1	1.270	.111	.739
Explained	9194.754	2	4597.377	402.527	.000
Residual	1130.706	99	11.421		
Total	10325.461	101	102.232		

For hypothesis 2, Table 5 shows that the P-value (Sig. of F) is 0.74. Since the Significance of F value (0.74) is greater than the alpha value (0.05), the null hypothesis was not rejected. The researcher, therefore, upholds the null hypothesis 2 and concludes that there is no significant difference in the mean achievement scores of male and female students taught Biology using standardized instructional materials.

H0$_3$:There is no significant difference in the mean achievement scores of male and female students taught Biology using improvised instructional materials.

Table 6: Analysis of Co-Variance for Students' Overall Biology Achievement Scores by Improvised Instructional Materials and by Gender.

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Covariates	9087.173	1	9087.173	951.949	.000
PRETEST	9087.173	1	9087.173	951.949	.000
Main Effects	.374	1	.374	.039	.843
GENDER	.374	1	.374	.039	.843
Explained	9087.547	2	4543.773	475.994	.000
Residual	1021.408	107	9.546		
Total	10108.955	109	92.743		

Hypothesis 3, Table 6 shows that the P-value (Sig. of F) is 0.84 which is greater than the alpha value (0.05), the null hypothesis was not rejected. The researcher, therefore, upholds the null hypothesis 3 and concludes that there is no significant difference in

the mean achievement scores of male and female students taught Biology using improvised instructional materials.

Discussion

Effects of Standardized and Improvised Instructional Materials on the Mean Achievement Scores of Secondary School Students in Biology.

Research Question 1 sought to determine the effect of standard and improvised instructional materials on secondary school students' achievement in Biology. Results relating to this research question are presented in Table 1. Students who were taught Biology using standardized and improvised instructional materials had higher achievement mean scores than those taught using no instructional material. Therefore, standardized and improvised instructional materials approach increased the achievement mean score of students in Biology more than the no instructional material group. Test of hypothesis 1 in Table 4 which stated that there is no significant difference in the mean achievement scores of students taught Biology using standardized and improvised instructional materials and those exposed to no instructional material approach, showed that there was a statistically significant difference between the achievements mean scores of the treatment groups and control group. The findings show that students taught with standardized and improvised instructional materials performed significantly better than the control group, indicating these methods effectively enhance Biology achievement. The high scores are likely due to increased student engagement, aligning with the Problem-solving Skill Theory (PSST) and Triarchic theory of intelligence, which emphasize active problem-solving and multisensory learning. Engaging multiple senses fosters better understanding, making these instructional approaches highly effective for improving student achievement

The finding of the study is in line with that of Ibe et. al. (2021), Anyakorah (2021) and Nuhu et. al. (2021) whom in their separate studies revealed that student taught Biology in the treatment group using improvised instructional material achieved better than those taught in the control group with no instructional material. The study is also in collaboration with Mike et. al. (2019) who observed that students taught science with standard instructional material performed better than their counterpart taught with no instructional material.; the findings of this study have demonstrated that use of standardized and improvised instructional materials is a veritable tool for boosting of students' achievement in Biology, which will bring about the achievement of the

objectives of Biology education in secondary schools. It is therefore imperative for Biology teachers to use standardized and improvised instructional materials in teaching Biology subject in secondary school. This is to enhance students' achievement in the subject as it involves the active engagement of students in the teaching and learning activities through creativity using available material.

Furthermore, since the finding also revealed a significant difference in the mean achievement scores of students taught Biology using standardized and improvised instructional materials and those exposed to no instructional material. The finding is in consonance with Ibe et al (2021) and Ezeliora et al (2021) whom in their different studies and fields observed a significant difference in the mean achievement scores of students taught with standardized and improvised instructional materials and those exposed to no instructional material in favour of students taught with standardized and improvised instructional materials. The significant different that exist among students taught with standardized, improvised and no instructional material could be as a result that students taught in treatment groups were exposed to materials unlike those in control group.

By the virtue of this findings, this study has joined the school of thought that investigated on effect of instructional materials (standard and improvised) on secondary school students' achievement in Biology and the significant difference in achievement of students taught with instructional materials and those taught with no instructional material.

Effect of Standardised Instructional Materials on the Mean Achievement Scores of Male and Female Students in Biology.

Research Question 2 was: What is the mean achievement scores of male and female students taught Biology with standardized instructional materials? As indicated in Table 2, it was found that male students had higher achievement mean score than female students. This finding implies that when Biology is taught using standardized instructional materials, male students will have greater achievement in Biology than female students. However, Test of Hypothesis 2, as shown in Table 5, which stated that there is no significant difference in the mean achievement scores of male and female students taught Biology using standardized instructional material was not rejected. The similar achievement scores between genders suggest that the use of standardized instructional materials promoted equal participation and motivation among male and female students. The interactive, engaging, and gender-inclusive teaching aligned with

Jerome Bruner's Discovery Learning Theory, which emphasizes problem-solving and internal reorganization to foster understanding. This approach likely reduced gender stereotypes, ensuring both genders benefited equally from the learning process. As a result, gender did not significantly influence the achievement, indicating that inclusive instructional strategies can promote equitable learning outcomes in Biology

The high mean achievement score of male students seemed to lend support to the assertion of some scholars who argued that males achieve higher than females in use of standardised instructional material (Ibe et al, 2021). However, the results of the hypothesis support the views of Yetunde (2020) observed that gender effect was not statistically significant in social studies using standard instructional material. More so, the finding supports the position of Hussaini, et al (2022) who report shows no significant difference among the sexes in optical concept. It is therefore the case that the standardised instructional material is favourable in improving achievement of the both gender categories. By the virtue this, the study has joined the school of thought that examined effect of standardised instructional materials on the mean achievement scores of male and female students in Biology and found no significant difference in the stated hypothesis.

Effect of Improvised Instructional Materials on the Mean Achievement Scores of Male and Female Students in Biology

Research Question 3 was: What is the mean achievement scores of male and female students taught Biology with improvised instructional material? As indicated in Table 3, it was found that male students had higher achievement mean score than female students. This finding implies that when Biology was taught using improvised instructional material, male students had greater achievement in Biology than female students. However, Test of Hypothesis 3, as shown in Table 6, which stated that there is no significant difference in the mean achievement scores of male and female students taught Biology using improvised instructional material was not rejected. Therefore, the difference between the achievement mean scores was not significant. The similar achievement scores suggest that the use of improvised instructional materials promoted equal motivation and participation among male and female students. The interactive, inclusive teaching approach supported by the Problem-solving Skill Theory allowed both genders to engage fully in learning Biology concepts. This gender-friendly environment likely minimized stereotypes, enabling students to benefit equally, and resulted in statistically equivalent scores. The strategy emphasized problem-solving

and active learning, fostering academic achievement across genders without bias or dichotomy

The higher achievement mean score of male students seemed to lend support to the assertion of some scholars who argued that males achieve higher than females (Ibe, 2017 & Mike, et. al. 2019). The finding is not support of Hussaini, et al (2022) who observed no significant difference among the sexes in optical concept and that of Abubakar, and Dembo (2018) who did a single sex study an found significant difference between the mean performances of female student taught in basic science concepts using real materials with lecture method compared to those taught with improvised materials. However, the results of the hypothesis support the views of Abanikannda (2021) who opined that there is no significant difference between male and female students in the impact of improvisation of learning resources on Biology instruction. This finding lends voice to the fact that Biology is not a gender-biased subject. More so, the finding of the study is also in line with Yetunde (2020), who reported that there is no gender disparity in achievement in Biology. But the finding did not supports the position of Williams and Otoyo (2021) who showed a significant difference between the mean achievement scores of students by gender. It is therefore the case that the improvised instructional material is favourable in improving achievement of the both gender categories. By virtue of this study, it has joined the school of thought that examined and observed a no significant difference among male and female students taught Biology concept using improvised instructional material.

Conclusion

The study has shown that from available research evidence that secondary school students have shown poor achievement in Biology which is especially evident in students' performance in public examinations. The persistent poor achievement in Biology has been of great concern to Biology educators and researchers. Among the factors identified to be responsible for the poor achievement is the teaching methods and instructional material used by the teachers.

This research was aimed at finding the effect of improvised and standard instructional materials in enhancing secondary school students' academic in Biology in Enugu state with the view to determining the efficacy of the instructional materials in improving both students' achievement in Biology. The findings of the study showed that the use of both instructional materials can enhance students' achievement in Biology significantly. The difference between the mean achievement scores of male and female students was not significant. The instructional materials therefore proved to be

effective in bridging the gap between male and female students in achievement in Biology.

Recommendations

Based on the findings the researchers recommended as follows:

1. Biology teachers should use both instructional materials (standardised and improvised) in teaching Biology in secondary schools as it enhances achievement in Biology.
2. Biology teacher-education programmes should incorporate the development of the skills of using both standardised and improvised instructional materials by pre-service teachers
3. Professional bodies like STAN should incorporate in their workshops, the training of Biology teachers on the effective use of the standardised and improvised instructional materials in Biology classrooms.

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