INMRJ
International Nexus Multidisciplinary Research Journal
April-May, 2025: https://journals.classicmultilinks.com
Impact Factor: 5.0. Vol: 1 Issue:2

EFFECTIVENESS OF IMPROVISED AND STANDARD INSTRUCTIONAL MATERIALS ON SECONDARY SCHOOL STUDENTS ACADEMIC RETENTION IN BIOLOGY

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Abstract

This study investigated how improvised and standard instructional materials affect secondary students' retention of knowledge in Biology. Guided by three research questions and hypotheses, the research used a quasi-experimental design in Enugu Education Zone, Enugu State. The population included 4,737 Senior Secondary II students across 33 schools. A sample of 316 students from six co-educational schools was randomly selected, with an almost equal gender split. The students were divided into three groups using balloting: one taught with improvised materials, another with standard materials, and a control group using conventional methods. The researcher developed the Biology Achievement Test (BAT) to measure pre-test scores, achievement after six weeks, and retention two weeks post-instruction. Data analysis involved mean, standard deviation, and ANCOVA at a 0.05 significance level. Results indicated a significant difference in retention scores, with students taught using either improvised or standard materials outperforming those taught with conventional techniques. No significant differences were found between male and female students' retention scores, nor was there a significant interaction between gender and instructional material. The findings suggest that using instructional materials whether improvised or standard enhances students' retention of Biology knowledge. The study recommends that Biology teachers incorporate such materials into their teaching to improve retention and learning outcomes. From the recommendations, conclusions were made.

Keywords: Biology, Performance, Retention, Improvised and Standard Instructional Material

Introduction

Biology is the scientific study of living organisms, their structures, functions, growth, evolution, and interactions with the environment. It helps us understand the diversity of life, how organisms survive, reproduce, and adapt to changes. Okolocha and Nwaukwa (2020) opined that Biology is crucial to

humanity as it advances medicine, agriculture, and environmental conservation, improving health and quality of life. It aids in solving ecological problems, preserving biodiversity, and managing natural resources sustainably (Hilma et al., 2022). But in spite of all these important of the subject to humanity, there are still evidence of low mean achievement scores and weaknesses reports in the subject among secondary school students just as reported by West African Examination Council (WAEC) and National Examination Council (NECO).

Between 2018 and 2022, Nigeria's WAEC and NECO Chief Examiners' Reports show that secondary students' average scores in Biology stayed below 50%, reflecting poor academic performance. Weaknesses are evident in understanding essential concepts like ecology, genetics, and cell biology, often due to inadequate knowledge of terminology, diagramming, and practical application. Students also struggle to identify ecological tools, label diagrams correctly, and comprehend biological systems. These issues alarm educators because Biology is vital for understanding life and the environment. Determining the underlying causes of these persistent weaknesses remains a key concern for stakeholders aiming to improve student retention. The question now is what could be the causes of these weaknesses that led to poor students' retention in some of these Biology concepts.

The causes of poor student retention in Biology concepts are intricately linked to the type and quality of instructional materials used in teaching. According to Okolocha and Nwaukwa (2020), inadequate demonstration of knowledge, often resulting from ineffective instructional aids, contributes to weak retention. Sabina et al. (2022) highlight that effective instructional materials are essential for engaging students and making complex or abstract concepts, such as ecology and genetics, more understandable and memorable. In resource-limited settings, reliance on improvised materials due to economic constraints—can lead to variable effectiveness. If poorly designed, these aids fail to deepen students' understanding, causing superficial learning and poor retention of concepts. Conversely, when available, standard materials tend to promote better retention by providing consistent, quality resources. However, the debate remains whether improvised or standard materials are more effective, as poorly prepared aids may result in shallow comprehension, rote learning, and reduced engagement. This hampers students' ability to connect ideas meaningfully, ultimately weakening their long-term retention and performance. Lack of adequate, appropriate instructional materials thus directly influences the depth of students' understanding and their capacity to retain (Ogunyebi, 2018).

No wonder Ibe, et. al. (2021), Mike et. al. (2019), Nwoke and Nwaneri (2016) found in their separate studies that there was high knowledge retention on the experimental group than the control group using Problem-solving Skill Theory and Triarchic theory of intelligence which engages multiple senses enhances problem-solving, retention, and understanding in Awka and Imo State respectively. Similarly, it has been stressed that to help students retain higher so that the basic objectives of Biology as a subject,

as well as the general objectives of the science education process, can be retained, teaching Biology should involve the use of instructional material (Williams & Otoyo 2021).

The higher retention mean score of male students seemed to lend support to the assertion of some scholars who argued that males retain higher than females (Oguche & Usman, 2019). However, Oguche and Usman, (2019) revealed that, there was no interaction effect of gender and type of instructional materials on students' retention using Jerome Bruner's Discovery Learning Theory in Nothern Nigeria. While Mike et. al. (2019) argued that retention is not a factor influenced by gender in Asia.

The higher retention mean score of male students seemed to lend support to the assertion of some scholars who argued that males retain higher than females (Williams & Otoyo 2021). No wonder Yetunde (2020) revealed that there is no significant difference in pre-test and post test scores between male and female students taught Biology with improvised instructional materials using Triarchic Theory of Intelligence and Creativity which emphasizes on the equal ability of all students to acquire, apply, and create knowledge regardless of gender Southern Nigeria.

All these reports and observations by scholars in other parts of the world and Nigeria in different subject on standard and improvised instructional material will not be generalised to secondary school students in Enugu State. Also, most these studies reviewed above do not use without instructional materials (WIM) in control group in their studies. They used some other instructional strategies especially the conventional once but this study, used WIM in control group as against two treatment groups. These gaps is what this filled. Thus, this study investigated the effectiveness of improvised and standard instructional materials on secondary school students' academic retention in Biology.

Purpose of the Study

The main purpose of this study is to investigate the effectiveness of improvised and standard instructional materials on secondary school students' academic retention in Biology. Specifically, the study seeks to examine the:

1. effect of standardized and improvised instructional material on the retention mean scores of secondary school students in Biology.
2. retention mean scores of male and female students taught Biology using standardized instructional materials.
3. retention mean scores of secondary school 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 material on the mean retention scores of secondary school students in Biology?
2. What is the mean retention scores of male and female students taught Biology using standardized instructional materials?
3. What is the mean retention scores of secondary school 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 on the secondary school students mean retention 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 retention scores of male and female students taught Biology using standardized instructional materials.
3. There is no significant difference in the mean retention scores of secondary school students taught Biology using improvised instructional materials.

Method

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 retention 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 post-test and retention-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 material on the mean retention scores of secondary school students in Biology?

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

Group	N	Adjusted Mean	Standard Deviation
Standardised Instructional Materials	102	78.15	9.30
Improvised Instructional Materials	110	78.43	8.89
No Instructional Materials	104	48.71	8.60

The summary of the result in Table 1 shows that the standardised instructional materials yielded a mean score of 78.15 with a standard deviation of 9.30, the improvised instructional materials yielded a mean score of 78.43 with a standard deviation of 8.89, while the non-use of instructional materials

produced a mean score of 48.71 with a standard deviation of 8.60. This indicated that the improvised instructional materials is superior to the standardised instructional materials (as it resulted to higher retention mean scores) and the non-use of instructional materials in facilitating students' retention in Biology.

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

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

Group	N	Adjusted Mean	Standard Deviation
Male Students	56	79.16	8.73
Female Students	46	76.91	9.90

The summary of the result in Table 2 shows that male students taught Biology using the standardized instructional materials had a mean retention score of 79.16 with a standard deviation score of 8.73 while their female colleagues taught with the same materials had a mean retention score of 76.91 with a standard deviation score of 9.90. This shows that male students taught Biology using the standardized instructional materials retained better than their female counterparts.

Research Question 3: What is the mean retention scores of secondary school students taught Biology using improvised instructional materials?

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

Group	N	Adjusted Mean	Standard Deviation
Male Students	54	79.30	9.05
Female Students	56	77.59	8.74

The summary of the result in Table 3 shows that male students taught Biology using the improvised instructional materials had a mean retention score of 79.30 with a standard deviation score of 9.05 while their female colleagues taught with the same materials had a mean retention score of 77.59 with a standard deviation score of 8.74. This shows that male students taught Biology using the improvised instructional materials retained better than their female counterparts.

Research Hypotheses

$H0_1$: There is no significant difference in the mean retention 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 Retention Scores by Instructional Materials

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Covariates	81952.156	1	81952.156	8018.887	.000
POSTTEST	81952.156	1	81952.156	8018.887	.000
Main Effects	902.979	3	300.993	29.452	.000
METHODS	875.139	2	437.570	42.815	.000
GENDER	10.403	1	10.403	1.018	.314
2-Way Interactions	18.893	2	9.447	.924	.398
METHODS*GENDER	18.893	2	9.447	.924	.398
Explained	82874.028	6	13812.338	1351.515	.000
Residual	3157.947	309	10.220		
Total	86031.975	315	273.117		

For hypothesis 1, the summary of the result in the ANCOVA table in Table 4 above shows that, for the comparison of the materials of instruction, the P-value (Sig. of F) is 0.00, which 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 there is a significant difference in the mean retention 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.

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

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

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Covariates	7621.063	1	7621.063	695.875	.000
POSTTEST	7621.063	1	7621.063	695.875	.000
Main Effects	25.505	1	25.505	2.329	.130
GENDER	25.505	1	25.505	2.329	.130
Explained	7646.568	2	3823.284	349.102	.000
Residual	1084.226	99	10.952		
Total	8730.794	101	86.444		

For hypothesis 2, Table 5 shows that the P-value (Sig. of F) is 0.13. which is greater than the alpha value (0.05), the null hypothesis was not rejected. The researcher, therefore, upholds the null hypothesis 6 and concludes that there is no significant difference in the mean retention scores of male and female students taught Biology using standardized instructional materials.

$H0_3$: There is no significant difference in the mean retention scores of male and female students taught Biology using improvised instructional materials.

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

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig of F
Covariates	7871.926	1	7871.926	1130.641	.000
POSTTEST	7871.926	1	7871.926	1130.641	.000
Main Effects	6.020	1	6.020	.865	.355
GENDER	6.020	1	6.020	.865	.355
Explained	7877.946	2	3938.973	565.753	.000
Residual	744.972	107	6.962		
Total	8622.918	109	79.109		

For hypothesis 3, Table 6 shows that the P-value (Sig. of F) is 0.36 which is greater than the alpha value (0.05), the null hypothesis was not rejected. The researcher, therefore, upholds the null hypothesis 7 and concludes that there is no significant difference in the mean retention scores of male and female students taught Biology using improvised instructional materials.

Discussion

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

Research question 1 sought to determine the effect of standardized and improvised instructional materials on the mean retention scores of secondary school students in Biology. Results relating to this research question are presented in Table 1. Students who were taught Biology using improvised instructional material had higher mean scores followed by those taught with standardised instructional material then no instructional material group. Therefore, the treatment groups increased the retention mean score of students in Biology more than the control groups. Test of hypothesis 1 in Table 4 which stated that there is no significant difference in the mean retention scores of students taught Biology using standardized and improvised instructional materials and those taught without materials, showed that there was a statistically significant difference between the retentions mean scores of the treatment groups and

control group. The findings show that the treatment groups' higher retention scores were statistically significant, indicating an effective approach to improving Biology retention. This success is likely due to multisensory engagement using both standardized and improvised instructional materials. Aligned with the Problem-solving Skill Theory and Triarchic theory of intelligence, engaging multiple senses enhances problem-solving, retention, and understanding. Therefore, multisensory instructional strategies effectively strengthen students' ability to retain and apply Biology concepts, making them valuable tools in education.

The finding of the study is in line with that of Ibe, et. al. (2021), Mike et al (2019), Nwoke and Nwaneri (2016) who found in their separate studies that there was high knowledge retention on the experimental group than the control group. Similarly, it has been stressed that to help students retain higher so that the basic objectives of Biology as a subject, as well as the general objectives of the science education process, can be retained, teaching Biology should involve the use of instructional material (Williams and Otoyo 2021); the findings of this study have demonstrated that application of instructional materials is a veritable tool for boosting of students' retention in Biology, which will bring about the retention of the objectives of Biology education in secondary schools. It is therefore imperative for Biology teachers to use instructional materials to enhance students' retention in the subject as it involves the active engagement of students in the teaching and learning activities.

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

Research question 2 was: What is the effect of standardized instructional materials on the mean retention scores of male and female students in Biology? As indicated in Table 2, it was found that male students had higher retention mean score than female students when taught Biology concepts with standardised instructional material. This finding implies that when Biology is taught using standardised instructional material, male students will have greater retention 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 retention scores of male and female students taught Biology using standardized instructional materials was not rejected. The similar retention scores indicate no significant difference between genders, suggesting that standardized instructional materials promoted equal motivation and participation. This interactive, gender-inclusive approach aligns with Jerome Bruner's Discovery Learning Theory, where contradictions in information stimulate internal discovery and improve retention. By creating a gender-neutral learning environment, the strategy minimized stereotypes, enabling both male and female students to benefit equally. Consequently, standardized instructional materials fostered equitable learning, supporting the idea that inclusive teaching methods can effectively enhance retention across genders. The higher retention mean score of male students seemed to lend support to the assertion of some scholars who argued that males retain higher than females (Oguche & Usman, 2019). However,

the results of the hypothesis support the views of Oguche and Usman, (2019) study revealed that, there was no interaction effect of gender and type of instructional materials on students' retention. This finding lends voice to the fact that Biology is not a gender-biased subject. More so, the finding supports the position of Mike et. al. (2019) who argued that retention is not a factor influenced by gender. It is therefore the case that the standardised instructional strategy is favourable in improving retention of the both gender categories. This finding has joined the school of thought that postulated an increase in male and female retention knowledge through use of standardised instructional material and no significant difference among male and female students taught Biology concept using standardised instructional strategy.

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

Research question 3 was: What is the effect of improvised instructional materials on the mean retention scores of male and female students in Biology. As indicated in Table 3, it was found that male students had higher retention mean score than female students. This finding implies that when Biology is taught using improvised instructional material, male students will have greater retention 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 retention scores of male and female students taught Biology using improvised instructional materials. The findings indicate no significant difference in retention scores between genders, suggesting that improvised instructional materials fostered equal motivation and involvement. The interactive, inclusive teaching approach aligned with the Triarchic Theory of Intelligence and Creativity, emphasizing the equal ability of all students to acquire, apply, and create knowledge regardless of gender. This gender-friendly environment reduced stereotypes, allowing both male and female students to benefit equally from the activities, promoting equitable learning outcomes.

The higher retention mean score of male students seemed to lend support to the assertion of some scholars who argued that males retain higher than females (Williams & Otoyo 2021). However, the results of the hypothesis support the views of Yetunde (2020) who revealed that there is no significant difference in pre-test and post test scores between male and female students taught Biology with improvised instructional materials. Thus this finding lends voice to the fact that Biology is not a gender-biased subject. This study has joined the school of thought that observed a higher retention mean score of male students than female students and no significant difference in retention when taught Biology concepts with improvised instructional material.

Summary of Findings

The result of the study revealed the following:

Students in treatment groups using standardized and improvised instructional materials had significantly higher retention scores than those in the control group, indicating the treatments' effectiveness. Although male students scored higher than females in both treatment groups, these differences were not statistically significant at the 0.05 level, suggesting they occurred by chance and are not systematic. Overall, the retention scores for males and females were statistically equivalent across both instructional methods, highlighting that gender did not significantly influence retention when quality resources were used

Conclusion

This research indicates that secondary school students, especially in Enugu State, exhibit poor retention in Biology, impacting their exam performance. This issue concerns educators and researchers, with teaching methods and instructional materials identified as key factors. This study examined the effect of improvised and standard instructional materials on students' retention. Results showed both materials significantly improved retention in Biology, with no significant difference between male and female students' scores. This demonstrates that effective instructional materials can enhance biological retention and help bridge gender gaps in learning outcomes

Recommendations

Based on the findings the researcher recommended as follows:

1. Biology teachers should use both instructional materials (standardised and improvised) in teaching Biology in secondary schools as it enhances retention 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.
4. The Government of Enugu State through the Ministry of Education should organize workshops for serving Biology teachers on the use of both standardised and improvised instructional materials
5. The Enugu State government should also equip schools with the needed functional educational technology facilities for the use of both standardised and improvised instructional materials in teaching.

References

Hilma, N. H., Jeriphanos, M. &Kelvien, C. (2022).Implementation of the Revised Biology Curriculum in Selected Junior Secondary Schools in Namibia. *Creative Educational Journal, 13(9), 1-10*. DOI: 104236/ce.2022.139187.

Ibe, F.N., Obkezie, M.C. &Chekendu, R.E.(2021).Effect of improvised instructional materials on chemistry students' academic retention in secondary school. *International Journal of Research in Education and Sustainable Development, 1 (5) 19-31.*

Mike, J., Eduardo, G.N., Peter, M.C.P., Zach, T., Rolf. E.C. & Joel, H. R. (2019). Improving academic performance, belonging, and retention through increasing structure of an introductory biology course. *CBE Life Science Education, 18(4),53-66*

National Examination Council (2018). National examination certificate June/July 2020 chief examiners' report. Minnar, Niger state. Nigeria.

National Examination Council (2019). National examination certificate June/July 2020 chief examiners' report. Minnar, Niger state. Nigeria.

National Examination Council (2020). National examination certificate June/July 2020 chief examiners' report. Minnar, Niger state. Nigeria.

National Examination Council (2021). National examination certificate June/July 2020 chief examiners' report. Minnar, Niger state. Nigeria.

Nwoke, B. I. & Nwaneri, O. M. (2016). Effect of improvised instructional materials on senior secondary school students' achievement and retention in mathematics. *International Technology Research Journal,* 4(1). 1-9.

Oguche, B. A & Usman, K .O. (2019). Effect of improvised instructional materials on students' achievement and retention in longitude and latitude. *International Journal of Research and Innovation in Social Science (IJRISS),* 3(4), 313-320.

Ogunyebi, T.H., (2018). Enhancing science performance through think-pair-share strategies among college of education students in integrated science in Ekiti State, Nigeria. *International Journal of Education and Evaluation,* 7(5), 24-35.

Okolocha, C. C. & Nwaukwa, F. C. (2020). Effect of think-pair-share instructional strategy on students' academic achievement and self-efficacy in financial accounting in Abia State. *International Journal of Recent Innovations in Academic Research,* 4(1), 37-48.

Sabina, A., Markprince, K.E & Eric, O. (2022).The impact of instructional materials in teaching and learning of biology in the colleges of education in the central region of Ghana. *Open Journal of Education Research.* DOI 1031586/ojer.2022.400

West African Examinations Council (2018). West African senior school certificate examination May/June chief examiners' report (Nigeria). Yaba-Lagos, Nigeria.

West African Examinations Council (2019). West African senior school certificate examination May/June chief examiners' report (Nigeria). Yaba-Lagos, Nigeria.

West African Examinations Council (2020). West African senior school certificate examination May/June chief examiners' report (Nigeria). Yaba-Lagos, Nigeria.

West African Examinations Council (2021). West African senior school certificate examination May/June chief examiners' report (Nigeria). Yaba-Lagos, Nigeria.

West African Examinations Council (2022). West African senior school certificate examination May/June chief examiners' report (Nigeria). Yaba-Lagos, Nigeria.

Williams, H. Y. & Otoyo, C. N. (2021). Creativity in the improvisation and utilization of instructional materials forthe Nigerian school system. *International Journal of Public Policy and Administrative Studies. 11(3), 48-59.*

Yetunde, O. M. (2020). Effect of improvised instructional materials on biology practical skills acquisition in senior secondary schools in lagos state. *Journal of Educational Foundation University of Porthacourt, 3(9), 11-21.*