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Effects of Real Specimens on Retention in Biology Concepts among Secondary School Students in Bomadi, Delta State, Nigeria

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Abstract

The study investigated the effects of real specimens on retention in Biology concepts among secondary school students in the Bomadi local government area. The study employed a Pre-test Post-test non-equivalent control quasi-experimental design using intact classes. Three research questions and three corresponding null hypotheses guided the study. The Population of the study was five hundred and thirty-seven (537) Senior Secondary year one students during the 2023/2024 in Bomadi Local Government Area, Delta State, using a sample size of one hundred and one (46 males & 55 females) students selected from two coeducational public schools using the multistage sampling technique. The Biology Retention Test (BRT), with a reliability coefficient of 0.791, was used to collect data for the study. T-test of independent samples and Analysis of Covariance (ANCOVA) were used to test the hypotheses at a 0.05 level of significance. Results revealed that students taught Biology concepts using real specimens had significantly higher retention scores than their counterparts taught without real specimens. There was no significant difference in the mean retention scores by gender or the interaction of gender and method. It was recommended that Biology teachers should use real specimens to facilitate students' retention of Biology concepts and improvement of academic achievement in Biology at the senior secondary school certificate examinations. Government and other stakeholders, like the Parents, Teachers' Association should make efforts to provide real specimens to Schools.

Keyword: Real Specimens, Retention, Gender, Hands-on specimen, Biology learning

Introduction

A focal point for improving science education and its products globally is improving science teaching. Meaningful learning is a product of retention. Inability of students to retain what they have learnt has been pointed out as one of the contributing factors to students' poor achievement in the sciences. Retention is the ability to remember things. Among the attributes of retention that are closely related to success are the ability to recall (memory) and to recognize. Memory is the capacity to retain an impression of past experiences. According to the Chief Examiner's report (WAEC, 2022), learners performed poorly in Biology due to inadequate knowledge of the identification procedure and inability to retain structures in organisms and their functions. According to Neboh (2011), if one cannot retain what one has learned, then there is no reason to expect that they will perform well in that activity in the future. This point is emphasized in the definition of retention by Adegbenro et al. (2013), who defined retention as the ability to reproduce the learned concept when the need arises. They further added that students' interest and retention could be stimulated and maintained through the use of appropriate instructional materials, such as real specimens or pictorial representations. Burke (2013) stressed that retention of what was learned is also linked to sensory experience. This implies that the level of retention is influenced by the type of material used. In teaching and learning concepts in Biology, different senses are engaged. Biology is the study of living things with abundant activities that learners can engage in. Opportunity to observe, touch, and feel these specimens in their natural forms conveys information which are difficult to forget.

Enohuean (2015) citing Onasanga and Adegbija (2008) explained that there is no need teaching if what is learnt cannot be recalled. Igiri and Effiong (2015) in the same light expressed the view that real aid ensures better retention ability, thus making learning more permanent while) Literature also suggest that the nature of the instructional materials contribute to



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level of retention ability in students (Abubakar et al. 2024; Jerono, 2024; Enohuan, 2015). Gaikwad (2013) suggests that perception, understanding, transfer of training, recall, and retention are enhanced when instructional materials are matched to the specific objectives of the lesson. Students could understand and retain the meaning of Biology concepts when they have seen or touched some objects associated with such concepts. The use of real materials in teaching Biology is very important because it provides a concrete basis for retention, which motivates students to learn more. Students understand and retain the meaning of a word better when they have seen or touched some object associated with it. A good understanding and retention of what is being taught in class by teachers requires the effective use of instructional aids (Umeohana, 2025; Olatoye, 2017). Several studies have revealed an unimpressive students' retention rate at the senior secondary school level in Nigeria. They have attributed the students' poor retention capacity to the use of inappropriate and ineffective teaching methods, such as the lecture method and the non-use of instructional materials such as real specimens and pictorials. In this regard, inappropriate teaching method and instructional materials used by Biology teachers invariably translates to students' inability to retain and put into practice what is learnt in reality. Okoye (2012) expressed the view that knowledge gained through practical work is easily retained and recalled than that acquired through theoretical teaching.

A growing body of research underscores the powerful role of visual and hands-on instructional aids in enhancing students' understanding, recall, and long-term retention of scientific concepts (Moemeke, 2024; Caroline et al., 2024; Junco & Nabua, 2023). Ngonyani (2018) found that when visual aids are effectively integrated into teaching, they not only strengthen comprehension and memory but also boost learners' motivation, engagement, and interest in the lesson. Similarly, Enohuan (2015) reported that students taught biology concepts with instructional materials retained information significantly better than peers in control groups who were taught without such aids. Evidence from subject-specific strategies also supports this conclusion. Arokoyu and Obunwo (2014), for example, examined the use of concept mapping for teaching organic chemistry and discovered that students exposed to this method retained concepts better than those taught using conventional methods, with mean scores of 60.67 for the experimental group compared to 54.00 for the control group. In another study, Olatoye (2017) investigated the effects of charts, real specimens, and videos on secondary school students' achievement in the mammalian skeletal system. The results showed that students taught with real specimens demonstrated a higher retention ability than those taught with charts, videos, or without instructional materials altogether.

A similar finding was reported by Igiri and Effiong (2015), whose study in Yakurr LGA revealed that students in the experimental group taught with instructional materials outperformed the control group in retention tests. Enohuan (2015) further emphasized that the nature of instructional materials—particularly their concreteness, meaningfulness, and ability to evoke mental imagery—can influence retention levels. However, retention is not solely determined by instructional materials. The gender effect on students' achievement and retention of Biology concepts has been a subject of debate for decades. In Nigeria, prevailing societal perceptions sometimes suggest that boys are superior to girls in physical strength, intelligence, and reasoning. Some educators even hold the view that girls are less capable of competing in science. While some studies suggest that boys outperform girls in retention, others report the opposite, and many find no significant difference at all. For instance, Enohuan (2015) found a significant difference in retention between male and female students taught with instructional materials, suggesting gender-based variations. Conversely, Attah (2014), Moemeke, (2024) and Buckley et al. (2021) have argued that gender does not significantly influence science retention and that any difference may be as a result of other variables. Nja, et al. (2015) also found no significant gender difference in retention scores when teaching thermochemistry with or without kitchen resources. Similarly, Ibe et al, (2021) reported no interaction effect between gender and the type of instructional materials used in chemistry lessons. Given these mixed findings, the present study sought to investigate both the effect of real specimens on the retention of biology concepts and the influence of gender in this context. By addressing these two dimensions, the research aims to provide deeper insights into how instructional strategies and learner characteristics interact to shape educational outcomes.

The persistent decline in students' academic achievement in the sciences remains one of the most pressing challenges facing secondary education in Nigeria, and schools in Delta State are no exception. Successive West African Examinations Council (WAEC) Chief Examiners' Reports (2016, 2017, 2018) consistently highlight poor performance in Biology, a trend that undermines the quality of instruction and learning outcomes in the subject. Studies by Auwal, Muhammad, and



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Mohd (2014) corroborate that Biology performance at the Senior Secondary Certificate Examinations (SSCE) has been subpar for several years. Omoifo (2012), as cited in Mezue, Urevbu, and Omoifo (2017), further emphasized the troublingly low levels of achievement and mastery among students. One key factor contributing to this trend is the inadequate use of effective instructional resources. In most classrooms, Biology lessons are still dominated by lecture-based delivery, textbook readings, and static illustrations, with little or no integration of real specimens. According to Okoye (2012), textbooks and picture-based materials alone cannot fully support the mastery of curriculum objectives, particularly for concepts such as movement, growth behavior, and taxonomy, which students understand best when they can observe organisms in their natural contexts. Enohuan (2015), referencing Tabotndip (2004), lamented that many Biology teachers have abandoned the use of authentic materials, resorting instead to abstract teaching methods that detach learners from practical realities.

The consequences of this approach are evident. WAEC Chief Examiners' Reports (2017, 2018) revealed that many candidates performed poorly in tasks requiring the identification of specimen parts and diagrammatic representation. Adebisi and Oladimeji (2020) noted that most Biology teachers prefer using illustrations or online images rather than authentic specimens for practical lessons—a finding echoed by Kpangban and Okoye (2015), who observed that models and drawings often replace real specimens in classroom teaching. If the goal is to foster lasting understanding and retention of biological concepts, reliance on artificial representations may be insufficient. The use of real specimens offers direct, sensory-rich, and contextually grounded experiences that can deepen comprehension and support long-term memory. This study, therefore, seeks to investigate whether integrating real specimens into Biology instruction can significantly enhance students' retention and achievement compared to conventional methods that exclude such resources.

Objectives of the study

The study was conducted to achieve the following objectives

1. To determine whether there is a difference in the retention of learned biological concepts by students taught biology using real specimens compared to those taught without them.
2. To ascertain if the use of real specimens has differential effects on male and female students' retention of learned biological concepts
3. Determine if students' gender interacts with the use of specimen type in influencing retention of learned biological concepts

Research Questions

To direct the investigation, the following research questions were posed:

1. What is the difference in the mean retention scores of students taught Biology concepts using real specimens and those taught without real specimens?
2. What is the difference in the mean retention scores of male and female students taught Biology concepts using real specimens?
3. Will there be any interaction effect of teaching method and gender on students' retention in Biology?

Hypotheses

The following null hypotheses were stated to guide the investigation. Decisions were made at a significance level of 0.05.

Ho₁: There will be no significant difference in the mean retention scores of students taught Biology concepts using real specimens and their counterparts taught the same concepts without real specimens.

Ho₂: There will be no significant difference in the mean retention scores of male and female students who were taught Biology concepts with real specimens.

Ho₃: There will be no significant interaction effect of teaching method and gender on students' retention score in Biology.

Methodology

This study employed a quasi-experimental pre-test post-test equivalent control group design with one experimental group and one control group. There was no randomization of students into groups, as intact classes were used. The population of the study was five hundred and thirty-seven (537) Senior Secondary one (SS1) Biology students in eight (8) public Government schools in Bomadi Local Government Area, Delta State. The sample consisted of one hundred and one (101) students in two intact classes.



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Data were collected using the Biology Retention Test (BRT). The BRT is a multiple-choice instrument with five response options A to E. The items were drawn from the identification and classification of Vertebrates (Pisces, Amphibians, Reptiles, Aves, and Mammals) in the senior secondary school year one (SS1) Biology curriculum used in Delta State. The BRT was given to a specialist in measurement and evaluation and an SS 1 Biology teacher in Delta State for face validity. The content validity of the instrument was ensured using the test blueprint. Kuder-Richardson formula (K-R 20), which provides an estimate of internal consistency of the instrument was used to obtain an internal consistency reliability coefficient of 0.79. Treatment duration was ten weeks. During the first week, the researcher visited each of the schools and obtained permission to use the schools for the research work. The pretest was also administered. From the second to sixth week, students were taught vertebrates. Students in the Experimental Group were taught the five classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, and Mammalia) for five weeks (two periods of forty minutes per week), given a total of ten (10) periods of teaching using real specimens. The students in the Control Group were taught the same content for the same duration, but without the use of real specimens. The Post-test was administered during the seventh week to each of the classes taught. In the tenth week, the same BRT instrument was re-administered to the students to test for retention. The pretest, post-test, and retention tests contain the same questions but in a different sequence.

Analysis of t-test was used to test Hypotheses 1 and 2, while Analysis of Covariance (ANCOVA) was used to test Hypothesis 3. Significance was determined at the 0.05 alpha level. This level of significance served as the basis for deciding whether to retain or reject the null hypothesis.

Presentation of Results

Ho₁: There will be no significant difference in the mean retention scores of students taught Biology concepts with real specimens and their counterparts taught the same without real specimens

Table 1: t-test analysis of the mean retention scores of experimental and control groups.

Groups	N	Mean	SEM	Df	T	Sig (2-tailed)
Experimental	42	35.59	1.856	85	16.247	.000
Control	45	16.22	.619			

$P \leq 0.05$ source: field (2025)

Table 1 reveals that students in the experimental group, who were taught using real specimens, achieved a mean retention score of 35.59, markedly higher than the 16.22 recorded for the control group taught without real specimens. To determine the statistical significance of this difference, an independent samples t-test was conducted, yielding $t(85) = 16.279$, $p < .001$. This value, being far below the 0.05 threshold, indicates a highly significant difference in retention between the two groups. Consequently, the null hypothesis of no significant difference in mean retention scores is decisively rejected, affirming that instruction with real specimens substantially enhances students' ability to retain biological concepts.

Ho₂: There will be no significant difference in the mean retention scores of male and female students taught Biology concepts with real specimens.

Table 2: t-test analysis of the mean retention scores of male and female students taught using real specimens

Sex	N	Mean	SEM	Df	t	Sig (2-tailed)
Female	24	.500	1.048	41	.068	.502
Male	18	.500	2.277			

Data source: source: field (2025) At significance of $P \leq 0.05$

Analysis of the retention scores by gender, as presented in Table 2, indicates that the mean retention score for female students (.500) was identical to that of male students (.500) among those taught Biology using real specimens. This initial observation suggests no apparent difference in retention based on gender. To statistically verify this, an independent samples t-test was conducted. The result produced a t-value of 0.068 with 41 degrees of freedom and a corresponding p-value of 0.502. Since the p-value exceeded the 0.05 level of significance, the null hypothesis—stating that there is no significant difference in the mean retention scores of male and female students taught with real specimens—was retained. This finding implies that, within the context of real-specimen-based instruction, gender did not influence students' ability to retain Biology concepts.



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Ho₃: There will be no significant interaction effect of teaching method and gender on students' retention score in Biology.

Table 3: Analysis of Covariance (ANCOVA) of the effect of real specimens on students' retention in Biology

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9796.033 ^a	4	2449.008	168.007	.000
Intercept	23.502	1	23.502	1.612	.208
POSTTEST	1431.485	1	1431.485	98.203	.000
RETENTION	430.750	1	430.750	29.550	.000
gender	75.560	1	75.560	5.184	.025
RETENTION * gender	13.922	1	13.922	.955	.331
Error	1195.300	82	14.577		
Total	68305.000	87			
Corrected Total	10991.333	86			

R Squared = .883 (Adjusted R Squared = .880)

Results in Table 3 show F - F-value df (1) = .955, and a significant value of .331. At the 0.05 level of significance, there is no significant interaction effect of method and gender on students' retention scores in Biology. Therefore, the null hypothesis is retained.

Discussion of Findings

Findings on retention of students taught Biology with real Specimens and those taught without real Specimens. The result showed that those who were taught Biology with real specimens had significantly higher retention ability than those taught without real specimens. Thus, this finding implies that the use of real specimens in teaching and learning of Biology increases students' retention ability. This finding conforms with the work of Olatoye (2017), who investigated the effect of teaching using charts, real specimens and videos on secondary school students' achievement in mammalian skeletal system concepts, found that the group taught Biology with real specimens had a higher retention ability than their counterparts taught with charts, videos and without (control group). The finding also corroborates that of Igiri and Effiong (2015), who investigated the impact of instructional materials in teaching and learning of Biology in senior secondary schools in Yakurr LG A, revealed that the experimental group taught with instructional materials had a better retention ability than the control group taught without instructional materials. The finding is also in line with Enohuan (2015), who carried out a study on the effect of instructional materials on achievement and retention of Biology concepts among secondary school students, found that students taught Biology concepts using instructional materials retained the learned concepts significantly better than their counterparts in the control group taught without instructional materials.

Results of the study on retention of male and female students taught Biology with real specimens, the finding showed that there was no significant difference between the mean retention scores of male and female students taught Biology with real specimens. Thus, this means that gender is not a significant factor in students' retention in Biology. This finding is in line with a research study by Nja et al. (2015), who investigated the interactive effect of gender and teaching with or without kitchen resources on the academic performance and retention of secondary school students in Chemistry in Calabar Education Zone, Cross River State, where it was found that there was no significant difference in the retention scores of male and female students taught thermochemistry with and without kitchen resources. However, the findings contrast that of Enohuan (2015), who reported that there was a significant difference in the retention ability of male and female students exposed to the use of instructional materials, which could be as a result of the nature of instructional materials used and instruments for data collection. Regarding the interaction effect of teaching method and gender on students' retention in Biology, the findings showed that there was no significant interaction effect between the two variables. This means that neither teaching method nor gender significantly affected students' retention in Biology. This finding aligns with Ibe et al. (2021), who investigated the effect of improvised instructional materials on chemistry students' academic retention in secondary school and found no interaction effect of gender and type of instructional materials on students' retention in chemistry (science). Therefore, based on the findings, there was no significant interaction effect of method and gender on students' retention in Biology.



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Conclusion

The findings show that students taught with real specimens had significantly higher retention ability than those taught without real specimens irrespective of student gender. It was therefore concluded that the use of real specimens in teaching and learning of Biology increases students' retention ability.

Recommendations

Based on the findings, it was recommended that Biology teachers should

1. Use real specimens to facilitate students' retention of learned Biology concepts.
2. Government and other stakeholders, like the Parents, Teachers Association (PTA), should regularly provide real specimens to school. This will make learning of biology concrete, real and also make learning concrete.
3. Mount regular training of teachers in sourcing, use and preservation of real specimens and other laboratory specimens
4. Entrench the teaching of laboratory procedures in teacher education curriculum at all levels so that Biology teachers can develop interest in collection and use of real specimens for teaching

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