



IMPACT OF IMPROVISED INSTRUCTIONAL MATERIALS ON TEACHING AND LEARNING BIOLOGY AMONG SENIOR SECONDARY SCHOOL STUDENTS IN DALA LOCAL GOVERNMENT AREA, KANO STATE

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Cite this article:

N. S. Muhammad, S. S. Janguza, M. A. Muhammad, R. Dhakar, S. Rabi, A. U. Labdo, A. T. Abubakar (2024), Impact of Improvised Instructional Materials on Teaching and Learning Biology Among Senior Secondary School Students in Dala Local Government Area, Kano State. British Journal of Computer, Networking and Information Technology 7(4), 139-153. DOI: 10.52589/BJCNIT-NGSF7TDW

Manuscript History

Received: 16 Jul 2024

Accepted: 11 Sep 2024

Published: 20 Dec 2024

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ABSTRACT: *Biology education is crucial for students to understand living organisms and their interactions with the environment. However, many schools struggle with limited access to teaching materials. This study investigated the impact of improvised instructional materials on biology education among senior secondary school students in Dala Local Government Area, Kano State. The research involved two schools, SSII classes from each school were assigned to control and experimental groups, totaling 346 students. Data was collected through surveys, classroom observations, and student assessments. Biology teachers were trained to design and use improvised materials in their curriculum. The findings revealed that improvised instructional materials improved teaching and learning in biology. Students in the experimental group showed better learning outcomes, higher engagement, and enhanced comprehension and retention of concepts. Quantitative data from post-tests were statistically analyzed to compare learning outcomes between the groups, while qualitative data from surveys were thematically analyzed to understand perceptions, challenges and benefits of using improvised materials. This study underscores the cost-effectiveness and practicality of improvised instructional materials, advocating for their adoption in schools. It provides insights for educators and policymakers to enhance biology education, innovative and student-centered teaching methods that foster a deeper understanding of life sciences among students.*

KEYWORDS: Biology, Improvisation, Instructional materials, learning biology.



INTRODUCTION

Education plays a vital role in the intellectual development of individuals within society. Educated individuals are better equipped to handle complex situations and provide valuable solutions. Ocho (2015) defined education as the process of equipping individuals with the necessary information, knowledge, and competencies for productive participation in society. This underscores the need to enhance the quality of education to produce competent citizens who contribute positively to national development. However, Nigeria's education sector faces several challenges, including the lack of access to and utilization of teaching resources at the secondary school level, which are crucial for meeting the demands of modern technology. A 2016 World Bank report highlighted that in many developing nations, the quality of education is poor, coverage is inadequate, and literacy levels are low, particularly in teacher effectiveness and the creation and use of educational resources. Orodho and Mugiraneza (2016) noted that most biology teachers do not employ instructional materials in their classrooms, leading to informal teaching methods. Fanen (2015) identified factors affecting the availability and sufficiency of educational materials, such as low educational funding, student population explosion, and the irrelevance of provided materials to the biology concepts being taught.

Biology education is fundamental in equipping students with a comprehensive understanding of living organisms and their interactions with the environment. It plays a crucial role in fostering scientific literacy, critical thinking, and problem-solving skills, which are essential for personal and societal development (Osborne & Dillon, 2008). However, in many resource-constrained environments, including various regions in Nigeria, the availability of comprehensive and high-quality instructional materials for teaching biology is often limited (Okebukola, 2002). This limitation can significantly hinder effective teaching and learning processes, leading to suboptimal educational outcomes.

Improvised instructional materials, created from readily available local resources, offer a practical solution to this challenge. These materials can bridge the gap caused by the scarcity of conventional teaching aids and enhance the learning experience by making abstract biological concepts more tangible and relatable (Aina, 2013). Research has shown that the use of improvised materials in science education can lead to improved student engagement, better understanding of concepts, and higher academic performance (Ajayi, 2008).

The technique of improvisation involves creating a brand-new tool, material, or instrument, as well as modifying an existing one, to serve a particular purpose. It is crucial to highlight the importance of improvising educational resources in secondary schools to enhance the teaching and learning process. By focusing on the improvisation of instructional materials, we can significantly improve the quality of instruction in our educational system. As Esu (2018) pointed out, effective teaching improvisation requires teachers to be creative, attentive, curious, and persistent. These qualities can only be developed through a well-structured improvisation training program.

The context of this study is Dala Local Government Area in Kano State, Nigeria, where schools often face significant challenges in accessing standard educational resources. By examining the impact of improvised instructional materials on the teaching and learning of biology among senior secondary school students in this area, this research aims to provide empirical evidence on the effectiveness of such materials. It also seeks to highlight the potential benefits and



challenges associated with their use, thereby contributing to the broader discourse on educational innovation and resource utilization in developing regions.

The shortage of resources in teaching and learning biology necessitates improvisation. Improvisation involves creating and using local resources in the absence of genuine ones, facilitating instruction where explicit first-hand teaching tools are lacking (Samba & Eriba, 2017). This study aims to determine the impact of improvised instructional materials on teaching and learning biology in senior secondary schools in the Dala Local Government Area of Kano State. The findings will provide valuable insights for teachers, enabling them to effectively produce and utilize locally made instructional materials in biology teaching. Additionally, this research will document the current availability and deficiencies of teaching materials in secondary schools in Dala and the state at large.

The findings from this study will be significant for the government, helping them identify how to assist and motivate teachers in improvising instructional materials for teaching various subjects. Curriculum planners will also benefit, as the study will inform provisions for teachers to produce instructional materials in the biology curriculum. Furthermore, the research will enable students to appreciate the importance of locally made instructional materials in learning biology, ultimately motivating them to improve their performance in the subject.

Statement of the Problem

It is vital to note that insufficient teaching resources in senior secondary schools in Dala Local Government, Kano State, severely impair the quality of biology education in general.

There exist resource-constrained conditions for most of the schools in the region, grossly delimiting the availability of conventional teaching aids. Inadequacy in quantity limits the quantum of complex biological concepts a teacher can effectively communicate and, consequently, student engagement and understanding. Accordingly, students usually miss the key concepts of biology, hence tainting their overall performance and interest in the life sciences.

Despite all the potentials that improvised instructional materials seem to hold towards the surmounting of such challenges, little empirical evidence exists as to their effectiveness in that particular regard. Teachers are usually not provided with training and resources for the attainment and implementation of such materials. The present study is the attempt to investigate how improvisation of instructional materials affects teaching and learning of biology in senior secondary schools of the Dala Local Government Area. During the process, it provides relevant and useful information and guides educators and decision-makers in taking effective measures to improve the standard of biology education in resource-poor environments.

Objectives of the Study

The objectives of this research are to:

1. Determine the effects of improvised instructional materials on the academic performance of biology students in Senior Secondary Schools in the Dala Educational Zone, Kano State, by comparing the performance of students taught with and without improvised instructional materials;



2. Compare the academic performance of boys and girls in biology when taught using improvised instructional materials in Senior Secondary Schools in the Dala Educational Zone, Kano State;
3. Assess the mean performance scores of students taught biology without the use of improvised instructional materials in Senior Secondary Schools in the Dala Educational Zone, Kano State; and
4. Explore the differences in treatment effects between students taught biology using improvised instructional materials and those taught without them in Senior Secondary Schools in the Dala Educational Zone, Kano State.

RESEARCH QUESTION

The following research questions were formulated to guide the study:

1. To what extent do improvised instructional materials affect the academic performance of biology students compared to those taught without improvised instructional materials in Senior Secondary Schools in the Dala Educational Zone, Kano State?
2. What are the comparative mean performance scores of boys and girls taught biology using improvised instructional materials in Senior Secondary Schools in the Dala Educational Zone, Kano State?
3. What are the mean performance scores of students taught biology without the use of improvised instructional materials in Senior Secondary Schools in the Dala Educational Zone, Kano State?
4. What effect does the use of improvised instructional materials have on the academic performance of students taught biology in Senior Secondary Schools in the Dala Educational Zone, Kano State?

Hypotheses

The following null hypotheses were formulated for this study:

- H₀₁: There is no significant difference in the academic performance of biology students taught using improvised instructional materials and those taught without improvised instructional materials in Senior Secondary Schools in the Dala Educational Zone, Kano State.
- H₀₂: There is no significant difference in the mean performance scores of boys and girls taught biology using improvised instructional materials in Senior Secondary Schools in the Dala Educational Zone, Kano State.
- H₀₃: There is no significant difference in the mean performance scores of students taught biology in Senior Secondary Schools in the Dala Educational Zone, Kano State without the use of improvised instructional materials.



LITERATURE REVIEW

Concept of Education

The primary way to fulfill this human right to education is through the school system. According to Patrick (2014), education is a social system that equips young people with the skills they will need to contribute to society as adults. Education is the process by which students acquire knowledge through instructional methods, environmental control, and the use of particular procedures that promote the best learning outcomes. With the acquisition of a structured body of information and skills that enable them to operate effectively in later life, the school's mission is to prepare the young for future obligations in life. The role that education can play as it relates to students in schools is crucial for advancing education for sustainable development and connecting the significance and meaning of sustainable development to daily life. One of the most crucial tools for bringing about change in any community is education, and schools are the primary setting where this education is provided. The institution of the school has been acknowledged as being enduringly human. Most often, physical changes to schools have been made rather than improvements to the working conditions of teachers and students. Secondary education strives to prepare students for both further education and practical living in society.

Concept of Improvised Instructional Materials

The development of relevant skills, mental, physical, and social abilities and competencies as tools for people to live and contribute to the development of society is one of the objectives of Nigeria's educational system (Federal Government of Nigeria, 2004). The lack of instructional materials for assuring effective teaching and learning for better results among students has hampered the achievement of this goal. According to reports, a barrier to successful teaching in schools is the lack of instructional resources (Adeyemi, 2017). As a result, pupils consistently perform poorly in a wide range of topics over time. For instance, various scholars have diverse definitions of improvised educational resources. According to Bajah in Eminah, (2016), it is the usage of imitation equipment when a real (ready-made) one is not available. According to Kamoru and Umeono (2016), it is the practice of utilizing locally available resources that the teacher has selected to enhance instruction. The art of improvisation involves a teacher creating straightforward but appealing and efficient teaching materials by utilizing local resources found in the educational setting. Locally produced educational materials include concepts and images of the supplies instructors typically prepare to support the development of children's physical, social, emotional, and cognitive skills. The educational tools are made to inspire youngsters to be independent and exploratory via play and interaction with other kids. As young children's thoughts and experiences connect with objects, ideas, and other people, they learn most effectively and have meaningful developmental experiences (Judy, 2014).

Purpose of Improvising Instructional Materials

Instructional materials are the pertinent resources that a teacher uses during the social studies instructional process to enhance teaching and learning and to make the instructions' substance more useful and less ambiguous. So, provided that they allow the acquisition and evaluation of information, skills, attitudes, morals, and values, such resources may be both human and non-human (Esu, 2018). It has been discovered that common terms or verbalization are insufficient for efficient instruction. The dissemination of messages, information, ideas, and knowledge is



facilitated by the use of instructional materials. They can consequently be controlled, witnessed, heard, felt, or discussed. They make things happen. They are anything or anybody the teacher turns to for help in his learning process (Esu, 2018). The interactive nature of some of the materials makes the learner part of the learning process. Improvised instructional materials according to NTI (Module Two) are of paramount importance in the teaching and learning of Social Studies because of the following functions they perform:

1. They speed up learning while giving teachers more time to engage in other profitable endeavors.
2. They create an experience reality that encourages learners to take an active role in their own learning.
3. They offer educational opportunities outside of the traditional classroom setting.
4. They promote practical learning and discourage memorization.
5. They provide practicality and realism to abstract terms, notions, and generalizations.
6. They support students in maintaining focus throughout the teaching-learning process.
7. They give the instructor the tools to direct and regulate the students' desired reactions to the learning circumstances' stimulus elements.
8. They help students become more conscious of the issues at hand, provide opportunities for inquiry, and model meaningful interactions—all of which inevitably result in the offering of answers.
9. They support the development of intentional and useful self-activity, which is far more beneficial to education than largely inactive and frequently boring listening.
10. They facilitate better communication between the teacher and the students in the classroom, which will lead to the anticipated improvement in learning outcomes.

Rationale for Improvisation of Instructional Materials

Concepts must be presented in a variety of contexts in order to be learned effectively. Without using sufficient and varied teaching and learning materials, a creative teacher is required in order for this to be accomplished (Adeyanju in Eminah, 2019). Learners vary in a number of ways. Each student's social and intellectual background varies (Coppin in Eminah, 2019). As a result, not all of the resources offered satisfy the interests and needs of students. Consequently, it makes sense to provide locally produced educational resources to balance activities among the various learner categories. The following are some of Ogbeh's (2017) justifications for improvisation:

- i. It helps us reach our educational goals by giving students the chance to acquire the practical, cognitive, and attitudinal skills they need to contribute positively to society.
- ii. When an instructor makes an effort to improve, it allows him to reconsider and look for better, more affordable ways to educate or help pupils learn. This suggests that it fosters independence and inventiveness.



- iii. By offering students a frame of reference to focus on during class activities, improvisation helps to partially fill the void left by a lack of supplies.
- iv. Scholars refer to improvisation as providing students the bread of living experience rather than the stone of abstract theory because it creates a cognitive bridge that leads them from abstraction and the "mental indigestion" that accompanies it to a nodding acquaintance with reality.
- v. It is obvious that improvisation is required in situations where equipment is available but not inexpensive, where technical know-how is missing for preserving or repairing equipment, or when replacement parts and spare parts are hard to come by.

METHODOLOGY

The design used was a quasi-experimental field setting, which was a pre-test, post-test, non-equivalent control group design. This study assessed the effect of improvised instructional materials on biology education among senior secondary school students in Dala Local Government of Kano State. Such a design allows for a comparison of students taught with improvised instructional materials and those taught using the conventional method, taking into consideration the pre-existing group differences. The research focused on science students in Senior Secondary Schools I-III in a total of 12 schools situated in the Dala Local Government Area. The two purposely selected schools were Government Secondary School Rigimatu, a boys' school, and Government Secondary School Bulukiya, a girls' school. From each school, two intact classes at the SSII level were randomly allocated to either the control or the experimental group. This resulted in four classes—two control and two experimental—with a population of 346 students, comprising 128 boys and 218 girls. The sample size was determined by using the Krejcie and Morgan formula of 1970, thereby ensuring statistical representation and validity. Data were collected using two instruments: a 15-item objective test entitled "Biology Achievement Test" (BAT) and a questionnaire entitled "Impact of Improvised Instructional Materials Questionnaire" (IIMQ). BAT has questions of two marks each and it has a total of thirty marks. It was specially designed for the study by the researcher, guided by a table of specification. The instruments were subjected to two senior lecturers in the Department of Science Education, Bayero University Kano, to establish their validity; this ensured content and face validity. This validated that the instruments measured what they are intended to measure.

Reliability was checked using twenty SSII students at Government Secondary School, Dala, outside the sample. All of them were administered the BAT and the reliability coefficient was computed with the Kuder-Richardson KR21 formula. A coefficient of 0.83 was obtained. Method of Data Collection: The instrument was pre-tested on all the four groups; afterwards, the instructional procedure spanned a week in which the experimental group was taught with improvised materials with the assistance of the researcher. Traditional "chalk and talk" instruction occurred in the control group. After a week of instruction, a posttest was administered to both groups and a delayed posttest a week later to the experimental group. Data were analyzed using t-tests to determine acceptance or rejection of the null hypotheses.

RESULTS

Presentation of Demographic Data

This section provides an analysis of the demographic data of both students and teachers involved in the study.

Table 1: Students' Demographic Information

Items	Variables	Frequency	Percent (%)
Gender	Males	128	38.5
Gender	Females	218	61.5
Total		346	100

Table 1 summarizes the demographic distribution of students from the selected schools. The table indicates that out of the total 346 students, 128 (36.99%) are male, and 218 (63.11%) are female.

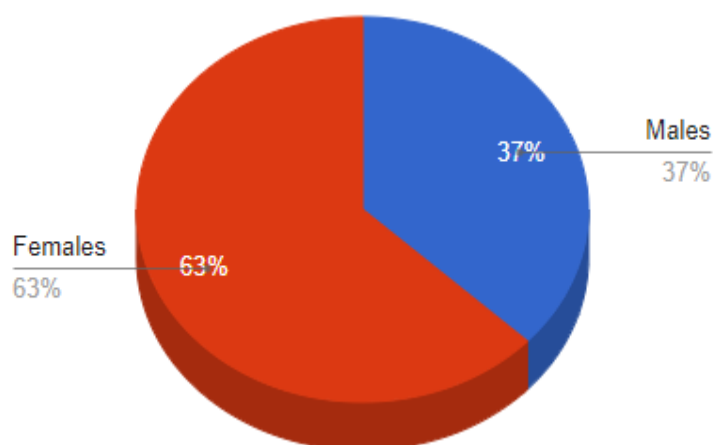


Figure 1: Pie chart showing students' gender distribution

Table 2: Teachers' Demographic Information

Items	Variables	Frequency	Percent (%)
Gender	Males	10	50
	Females	10	50
Total		20	100
Years of Experience	0-5	5	25
	6-10	3	15
	11-15	9	45
	16-20	0	0
	21-above	3	15
Total		20	100
Qualification	Diploma	2	10
	NCE	4	20
	Degree	12	60
	M.Sc	0	0

	PhD	0	0
Total		20	100

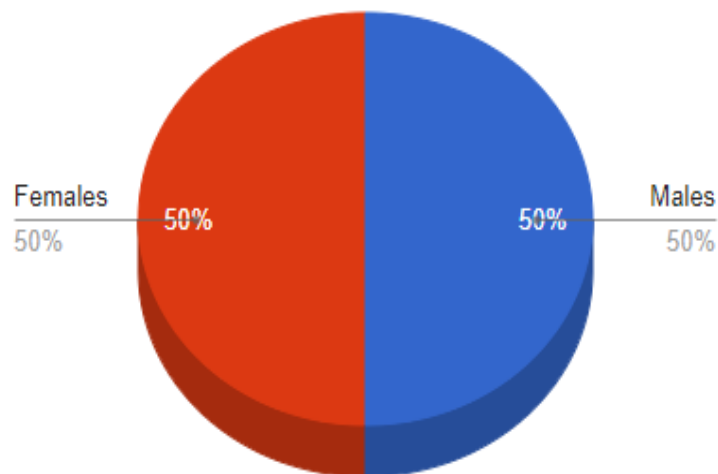


Figure 2: Pie chart showing teachers' gender distribution

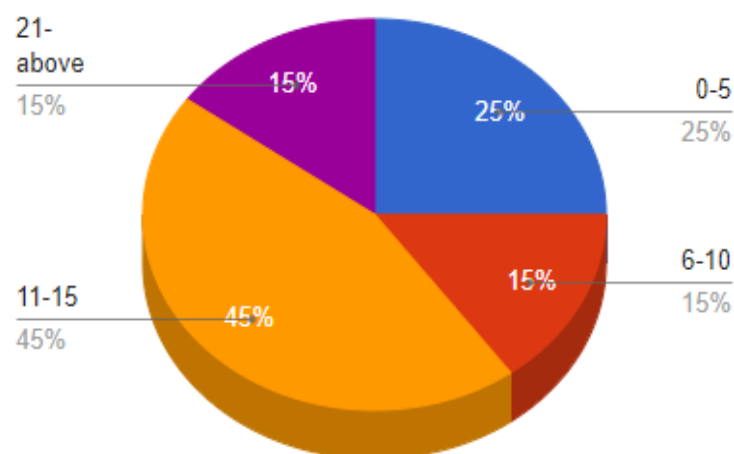


Figure 3. Pie chart showing teachers' years of experience

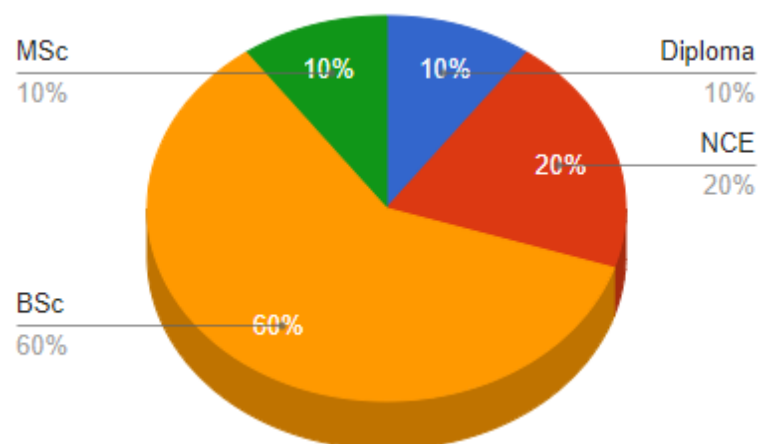


Figure 4: Pie chart showing teachers' qualifications distribution



Table 2 details the demographic data of the teachers from the selected schools. It shows an equal distribution of gender with 50% males and 50% females. The distribution of years of experience is as follows: 0-5 years (25%), 6-10 years (15%), 11-15 years (45%), 16-20 years (0%), and 21 years and above (15%). Regarding qualifications, the teachers have the following degrees: Diploma (10%), NCE (20%), Degree (60%), M.Sc (10%), and Ph.D (0%).

Table 3: Teachers' Responses on the Use of Improvised Instructional Materials

S/N	Items	Agree (A)	Strongly Agree (SA)	Disagree (D)	Strongly Disagree (SD)
1	Regular use of improvised instructional materials enhances teaching process	16 (80%)	4 (20%)	0 (0%)	0 (0%)
2	Use of improvised instructional materials makes learning faster	9 (45%)	11 (55%)	0 (0%)	0 (0%)
3	Use of improvised instructional materials promotes retention	11 (55%)	9 (45%)	0 (0%)	0 (0%)
4	Use of improvised instructional materials is time-consuming when construction	13 (65%)	4 (20%)	3 (15%)	0
5	Not all topics can be taught with improvised materials	9 (45%)	7 (35%)	2 (10%)	2 (10%)

Table 3 presents the teachers' responses regarding the use of improvised instructional materials. A significant number of teachers agreed with the statements in items 1, 3, 4, and 5 (80%, 55%, 65%, and 45%, respectively), while a notable proportion strongly agreed with item 2 (55%). The results reflect a positive reception of improvised materials, although some concerns about their time-consuming nature and applicability to all topics were also noted in item 3 (60%).

Table 4: Teachers' Responses on Factors Militating Against the Use of Improvised Instructional Materials in Teaching Biology among Secondary School Teachers

S/N	Items	SA	A	D	SD
1	Teachers must acquire skills in developing appropriate improvised instructional materials.	14 (70%)	6 (30%)	0 (0%)	0 (0%)
2	Degree of accuracy and precision are not possible with improvised instructional materials.	10 (50%)	3 (15%)	6 (30%)	1 (5%)
3	Lack of professional training like workshops and seminars are major problems militating against the effective use of improvised instructional materials by teachers.	6 (30%)	12 (60%)	2 (10%)	0 (0%)
4	Lack of financial assistance makes the construction of improvised instructional materials impossible.	12 (60%)	4 (20%)	3 (15%)	1 (5%)
5	Most teachers develop less interest in using improvised instructional materials.	13 (65%)	3 (15%)	4 (20%)	0 (0%)

Table 4 reveals that a significant number of teachers strongly agreed with items 1, 2, 4, and 5 (70%, 50%, 60%, and 65%, respectively). Additionally, a significant number of teachers agreed with item 3 (60%).



Analysis of Research Questions

Research Question One: To what extent do improvised instructional materials affect the academic performance of Biology students compared to those taught without these materials in Senior Secondary Schools in Dala Educational Zone, Kano State?

Table 5: Mean and Standard Deviation of Test Scores

Group	N	Mean	SD
Experimental Group	200	17.49	4.48
Control Group	146	10.11	3.42

Table 5 indicates that students taught the circulatory system using improvised instructional materials had a mean achievement score of 17.49 (SD = 4.48) in the post-test, compared to 10.11 (SD = 3.42) for those taught with traditional methods. This suggests that the use of improvised instructional materials resulted in significantly higher academic performance among students.

Research Question Two: What are the comparative mean performance scores of boys and girls taught Biology using improvised instructional materials in Senior Secondary Schools in Dala Educational Zone, Kano State?

Table 6: Mean and Standard Deviation of Male and Female Students

Group	N	Mean	SD
Male	75	17.43	4.82
Female	125	17.57	4.11

Table 6 shows that male students had a mean post-test score of 17.43 (SD = 4.82), while female students scored a mean of 17.57 (SD = 4.11) when taught using improvised instructional materials. Although female students scored slightly higher on average, the difference in performance between male and female students was not substantial. Hypothesis H0₂ was tested to assess if this difference was statistically significant.

Testing Research Hypotheses

The data analysis for this study is presented according to the research hypotheses, which were used to answer the research questions.

Hypothesis H0₁: There is no significant difference in the academic performance of Biology students taught using improvised instructional materials and those taught without improvised instructional materials in Senior Secondary Schools in Dala Educational Zone, Kano State.

Table 7: t-Test Statistics of Post-Test Scores

Group	N	Mean	SD	df	t-value	Sig
Experimental	200	17.49	4.48	178	-7.39	0.05
Control	146	10.11	4.42			

Table 7 reveals the t-test statistics for the mean achievement scores of students taught the human circulatory system using improvised instructional materials versus those taught using conventional methods. The results indicate a significant difference between the two groups (t



= -7.39, $df = 178$, $p < 0.05$). The experimental group, which used improvised materials, had a mean score of 17.49 ($SD = 4.48$), compared to the control group's mean score of 10.11 ($SD = 4.42$). Consequently, the null hypothesis is rejected in favor of the experimental group.

Hypothesis HO2: There is no significant difference in the mean performance scores of boys and girls taught Biology using improvised instructional materials in Senior Secondary Schools in Dala Educational Zone, Kano State.

Table 8: t-Test Statistics of Mean Achievement Scores

Group	N	Mean	SD	df	t-value	Sig
Male	75	17.43	4.82	77	0.14	0.05
Female	125	17.57	4.11			

Table 8 shows the t-test statistics for the mean achievement scores of male and female students taught the human circulatory system using improvised instructional materials. The results ($t = 0.14$, $df = 77$, $p > 0.05$) indicate no significant difference between the performance of male and female students. Thus, the null hypothesis is accepted, suggesting that gender does not significantly affect the achievement scores when using improvised instructional materials.

DISCUSSION OF THE FINDINGS

The analysis of the data reveals several key findings. The post-test scores indicate that the experimental group (mean = 17.49, $SD = 4.48$) achieved significantly higher scores than the control group (mean = 10.11, $SD = 3.42$). The t-test result ($t = -7.39$, $p < 0.05$) confirms that the use of improvised instructional materials has a significant positive impact on students' academic performance, consistent with findings by Ehikioya (2000), Olagunjo (2000), Abolade (2004), Olagunju (2000), Mbajiorgu (2003), Onasanya and Omosewo (2010), and Adeyemi and Olaleye (2010), who reported similar impacts of improvised materials on student achievement.

Regarding gender differences, male students (mean = 17.43, $SD = 4.82$) scored slightly lower than female students (mean = 17.57, $SD = 4.11$), but this difference was not statistically significant ($t = 0.14$, $p > 0.05$). This supports the findings of Onasanya and Omosewo (2010), who also found no significant difference in achievement scores between male and female students using improvised instructional materials. Therefore, gender does not appear to significantly affect the academic outcomes of students taught with these materials.

CONCLUSION AND RECOMMENDATIONS

The use of improvised instructional materials clearly improved students' performance in biology more than the conventional method of teaching. The result showed that students exposed to improvised materials performed better than their counterparts using conventional materials, thus confirming the effectiveness of improvised materials on students' comprehension and retention. There was no significant difference in achievement by male and female students, proving that their gender had no influence on how effective improvised



instructional materials are in teaching biology. Based on the findings, several recommendations are made. One, biology instruction should involve improvised teaching aids to improve students' performance. Teachers should be encouraged to improvise and make use of such aid within the locally available resources so that most abstract biology concepts become more familiar and concrete. Two, professional development workshops on improvisational skills should be regularly organized for teachers to assist them in improving and upgrading their teaching methodology.

Such comparison in the impact of improvised and traditional methods of teaching on learners with differentiated ability levels and on memory retention in biology will be interesting for future research. Robust experimental designs would go further to extend the conclusion. More research in other Local Government Areas and on other biological concepts will further generalize the findings for different contexts and topics.

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