Effects of the Use of Instructional Materials on Senior Secondary School Students' Achievement in Biology in Oyo town, Oyo State

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Certification

This is to certify that this research entitled "Effects of the Use of Instructional Materials on Senior Secondary School Students' Academic Achievement in Biology in Oyo town, Oyo State" was carried by Saudat Titilope ADEYANJU with matriculation number LCU/PG/003788 in the Department of Science Education, Faculty of Education, Lead City University, Ibadan, Oyo State, for the award of Master of Science Education Degree (MSc(Ed)) in Biology Education, and that this has not been previously submitted to any institution for award of any degree or certificate.

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Dedication

The research work is dedicated to Almighty Allah, The beginning and the end and my daughter, Zaynab Boluwatife Asabi.

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Abstract

The abstract nature of respiratory physiology, combined with limited hands-on experiences and interactive learning opportunities, impedes students' understanding and retention of crucial concepts. Furthermore, the inadequate access to high-quality instructional materials exacerbates the issue, leaving students without sufficient resources to supplement their classroom learning. This study therefore determined the effects of standardised and improvised instructional materials on the academic achievement of Senior Secondary School Biology students in respiratory system topics in Oyo town, Nigeria. This study was guided by 11 hypotheses. The study was also grounded on constructivist and cognitive theories and adopted the pretest-posttest quasi experimental research design of 3x2 factorial matrix. The study population consisted of 13,716 senior secondary school students in the Oyo town. The purposive sampling technique was employed to select three intact classes of 149 SSS 11 students. Biology Achievement Test (BAT) (KR20 =0.8) was used as instrument for data collection. The data were analysed using ANCOVA at a significant level of 0.05. Result from the findings showed [$F_{(1;144)}$ = 46.627; P-value < 0 .05], significant effects of improvised instructional materials on academic achievement of Senior Secondary School Biology students in respiratory system [$F_{(1;144)}$ = 50.939; P-value < 0. 05], significant effects of standardised instructional materials on academic achievement of Senior Secondary School Biology students in respiratory system [$F_{(1;144)}$ =1.448; P >0.05], significant effect of conventional method on academic achievement of Senior Secondary School Biology students in respiratory system [$F_{(1;144)}$ =3.034; P- value >0.05], no significant effects of gender on academic achievement of Senior Secondary School Biology students in respiratory system and [$F_{(1;134)}$ = 0.620; p> 0.05]], no significant effects of improvised instructional materials, standardised instructional materials and gender on academic achievement of Senior Secondary School Biology students in respiratory system. Additionally, the absence of significant gender differences suggests that both male and female students benefited equally from the instructional approaches employed. These results underscore the importance of integrating diverse instructional strategies to improve learning environments in science education. The study offered practical implications for educators, curriculum developers, and teacher training programmes, emphasising the need for a blended approach that combines standardized and improvised resources to improve educational outcomes.

Keywords: Instructional Materials, Respiratory System, Academic Achievement in Biology, Gender differential

Word count: 296

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List of Acronyms

Abbreviation		Meaning
COPD	-	Chronic Obstructive Pulmonary
WAEC	-	West Africa Examination Council
SSS	-	Senior Secondary Schools
CLT	-	Cognitive Load Theory
BAT	-	Biology Achievement Test
ANCOVA	-	Analysis of Covariance

Chapter One
Introduction

1.1 Background to the Study

Academic achievement is a multi-dimensional, critical aspect of the entire educational terrain that embodies the experience, knowledge gained, and even the skills developed in students throughout an academic career. Assessment of academic achievement mostly revolves around measurement regarding performance in various subjects, examinations, assignments, and other related activities to education. Viewed as an asset, the academic achievement of students allows for both the effectiveness of instructional materials and teaching methods and individual success to be measured. Academic achievement is not solely about test scores; it also involves practical applications of knowledge, critical thinking, and solving problems. Teachers and policy makers willing to raise standards in regard to increasing the quality of education should have a broader understanding of those variables that influence academic achievement[1].

Biology forms the basis for the understanding of life and the different processes that occur around it, from the studies of living organisms concerning their structure, function, growth, evolution, and interaction with the environment[2]. Biology studies in detail the intricate machinery operating at a variety of levels of organization that control life-from the molecular and cellular to ecological and global dimensions. This multivariate approach enables the biologist to search for an explanation of the diversification and unity of life and allows a glimpse of how life is intricate and interconnected[3]. Indeed, biology has changed substantially over centuries due to scientific discovery and the development of technology, along with integration across disciplines. From the early observations of naturalists to the modern instruments of molecular biology and genomics, the field has continued to expand its

purview as new layers of insight into the mechanisms of life were uncovered. Biology as a concept is in flux, always changing character, while reflecting the evolution of scientific inquiry and the search for knowledge about the natural world.

The basic principles and theories of biology provide a foundation to which the subject is hinged, establishing the frameworks with which the organization and interpretation of biological phenomena are carried out[4]. The relationship between structure and function, cell theory, and evolution by means of natural selection are some of the concepts guiding research in various ways; it joins different sub-disciplines together in their quest to unravel life. Moreover, biology serves as an integrative science in that principles from chemistry, physics, mathematics, and other fields are employed to study and solve complex biological phenomena and issues. The significance of biology in Nigerian education goes beyond classroom teaching into critical thinking skills development in students and an understanding of the natural world, which are crucial for both academic and professional lives.

The study of biology encompasses the fundamental branches of national curricula that have equipped students with the insightful abilities to explore life's wonders at various scales, from cellular life to ecosystems. Students grasp the problems in ecology and biological diversity through studying biology, whereby they are able to establish a critical judgment on the principles that govern life: the structure, function, and interaction with the environment of living organisms. The knowledge of biology education provides basic skills for scientific literacy, and scientific literacy acquires more importance as the society develops technologically and becomes more complex. Core competencies in the realm of scientific investigation include critical reasoning, hypothesis testing, data analysis, observation, and the

like that the students would be able to develop through active involvement in investigative projects, fieldwork, and experiments[4].

These skills not only enhance their understanding of biological knowledge but also allow them to apply judgment to evidence, make decisions, and provide relevant contributions to scientific debate and concerns in society[5]. Biology thus helps in making interconnections in other disciplines as well, thereby relating the life sciences to medicine, agriculture, environmental conservation, and biotechnology. Students review, through interdisciplinary approaches, how biology and its concepts are connected in relevance to the world around us and understand the role biological studies can play in determining urgent solutions for current global challenges on environment sustainability, disease prevention and food security[6].

This interdisciplinary approach will not only enhance the academic learning of students but also eventually prepare them with the skills needed for a diverse range of career paths and lifelong learning opportunities in an increasingly interconnected world. Biology education promotes better understanding of health and wellness that would enable students to make more informed decisions about their health and lifestyle. In research on human anatomy, physiology, nutrition, and prevention of diseases, students are able to grasp in-depth knowledge of the human body and factors affecting health outcomes. It forms the basis for life skills concerning health literacy, self-care practices, and disease prevention strategies important in ensuring well-being for individuals and communities within the diverse socio-cultural context of Nigeria[7].

Applications of Biology extend beyond the bench into every aspect of human existence and will continue to shape our view on biotechnology, agriculture, health, and ecology, among others. Innovation and decision-making in medicine, natural conservation, genetic

engineering, and biomedical research all have their basis in biological knowledge. Moreover, Biology is in the vanguard in dealing with global challenges on changing climates, lost biodiversity, and emergent infectious diseases, which also requires informed scientific inquiry and interdisciplinary collaboration[8].

One of the topics included in the curriculum under Biology is on the respiratory system. The Biology of respiration forms one of the major aspects of the field, where it offers in-depth details about the different mechanisms that help in sustaining life. The respiratory system provides the path for the exchange of gases between the organisms and the environment, through which organisms take in oxygen, used by many in cellular respiration, and expel carbon dioxide, a product of metabolism. This basic function forms the basis for aerobic metabolism, describing how organisms achieve energy from nutrients and, hence, power cellular activities essential to their maintenance and growth.

The respiratory system is an attractive point of focus in understanding how anatomical structure interrelates with physiological function and interaction with the environment in biological studies. It is anatomically a very complicated system of organs like lungs, bronchi, trachea, diaphragm, and associated structures. It does so from an anatomical perspective. Thus, with such detailed anatomical studies on the structural adaptations and functional specialisation of respiratory organs, one can gain a deep insight into morphological features associated with gas exchange, airways' maintenance and respiratory defense mechanisms[8].

The respiratory system opens a gate to researching wider physiological concepts, including the transport of gases, pulmonary ventilation, acid-base balance and regulation of breathing. In this, the amazing efficiency and adaptability of respiratory processes to changed conditions-both of the environment and physiological demands-are explored by students

through principles of gas diffusion, partial pressures, and oxygen-hemoglobin dissociation curves that unveil the mechanisms underlying gas exchange at the alveolar-capillary interface. This research, however, crosses the borders of anatomy and physiological studies into a complex, most intellectually rewarding interaction between respiratory health, disease, and the environment[9]. The deeper development of pathophysiological mechanisms in specific respiratory disorders, such as asthma, COPD, pneumonia, and respiratory infections, helps students develop a rounded appreciation of how environmental pollutants, tobacco smoke, and life styles may affect respiratory health outcomes[10].

Besides the purely biological importance of the respiratory system, knowledge in this subject area is of practical importance to a variety of disciplines, such as public health, sports physiology, environmental science, and medicine. The application of respiratory physiology and pathology enables decision-making and drives innovation in healthcare and environmental protection, workplace safety initiatives-from diagnostic techniques and therapeutic interventions in the clinical setting through air quality monitoring to occupational health assessments. In short, the respiratory system is a subject in the study of Biology that is interesting and complex because one may look into it from various interdisciplinary, anatomical, physiological, and pathological viewpoints. The students learn not only principles of biology but also find valuable insight into the dynamic relationship between living things and their environment, while studying the complexities of respiratory anatomy, function, and health that enriches an all-rounded appreciation of life's wonders and the fragile balance that supports it[11].

In Nigeria, the poor performance of students in Biology remains an issue of concern in topics involving the respiratory system. Studies and assessment have reinstated issues faced by

students regarding understanding and performance in biology examinations in specific topics touching on the respiratory system. This is evident from the 2022 WAEC report, which compared the performance of students in Nigeria in aspects of biology; the average scores realized for the questions related to the respiratory system were far lower compared to other sections in the biology curriculum. This situation shows that the difficulty faced by students is not isolated but rather is a common problem that is prevalent among students regarding the intricacies of respiratory physiology and anatomy, an integral part of biological education.

Poor performance in the respiratory system topics among Nigerian students emanates from a set of factors. First, during the learning process, the students have to face significant challenges; the nature of respiratory physiology is abstract, and it can be better comprehended by students who have access to a range of good instructional materials and laboratory facilities. One of such studies pointed out that because of a lack of laboratory facilities and instructional materials in the majority of schools in Nigeria, especially those in rural areas, students cannot demonstrate their practical understanding about the structure and functions of the respiratory system to develop manipulative skills[12]. Secondly, teaching modes and instructional approaches vary significantly within different schools operating in Nigeria. Other noticeable distinctions include student-centered learning and inquiry-based learning.

Contrary to that, most systems of education still extensively employ obsolete, inefficient lecture formats where rote memorisation of topics is encouraged over the development of critical thinking and problem-solving skills. Because of this discrepancy in the way teaching is carried out, there is inequality between students in terms of receiving effective teaching methods; this may lead to such students performing poorly in topics related to the respiratory

system or any other area of Biology[13]. Instructional materials are those which augment the teaching-learning process in any educational setting and include several materials and tools to be able to do so. There is a long list of types, including textbooks, multimedia equipment presentations, laboratory, digital resources, and manipulative that educators can use within the classroom setting to engage students in active learning, illustrate concepts, and present information[14]. Literature has pointed out that the range of learning materials promotes more adequate comprehension and memorization of content, enhancing interest and decreasing the school dropout rate of the learners, considering the variety in learning styles and preferences[15].

Furthermore, recent technology advancements have transformed the field of instructional materials by making various state-of-the-art tools comprising interaction simulations, virtual reality, and e-learning modules available, thus giving added value to pedagogic activities. The commitment by educators to investigate the capability of instructional materials to improve pedagogy and student performance will help in developing effective instructional materials that are available for use in a variety of educational settings. There is a desperate need for research and development. Print is one category of instructional material, textbooks, workbooks, and study guides are examples of print resources; these are often adopted as core resources for students since they present organized content in text form. Textbooks, in particular, are created to be instructional vehicles that satisfy course learning needs and offer a structured course of study, thereby guaranteeing comprehensive learning about a subject. In addition to print, teaching tools will incorporate visual learning devices such as charts, diagrams, and models[16].

Visual learning devices are to be used when concepts are abstract, when ideas are to be made concrete or tangible, and when there are different styles of learning. The graphic presentation of information has proved to be an invaluable part of the instructional arsenal in terms of both understanding and retention. Applications of digital instructional materials grow with technology. In this regard, interaction simulations, educational software, and e-learning modules have transformed the bases into lively, participatory supplements to the traditional materials. Such digital resources currently enable customisation, interactivity, and immediate feedback, thereby meeting the needs of today's educator and learner even better. Another important class is hands-on tools and apparatus used in the laboratory. Practical lessons and experiments allow students to get a real and practical knowledge of abstract facts. Laboratory materials, specimens, and scientific apparatus contribute to a deeper education by establishing a closer contact between theory and practice[17].

Educators must make a critical decision in the choice of instructional materials, which reflects the effectiveness of their teaching methods. Important considerations are such as: appropriateness and relevance of material content to the curriculum, matching the various learning needs of the students. Continuous development in educational technology has broadened the possibilities for original and effective instructional materials, which give educators a variety of options to improve the learning and teaching process. Instructional materials used in teaching students about the Respiratory System in Biology will be important determinants in the way they understand and participate in the subject matter. In the school setting, instructional materials refer to learning aids, resources, and tools. These materials can broadly be classified into two main categories, namely: improvised instructional materials and standardised instructional materials[18].

Improvised instructional materials refer to a resourceful and innovative method for improving the teaching and learning process[16]. These materials are generated either by the teachers themselves or sometimes with the help of students, whether in response to particular teaching needs or with a view to attending to the particular configuration of any given classroom, and often by exploiting resources available locally.

Improvised instructional materials constitute a flexible, dynamic method in the delivery of instruction. They may come in chart, diagrammatic, model, prop, and manipulative formats, and others. The potential for improvised instructional materials to accommodate students' diverse learning styles and preferences is a strong plus. Educators are able to customise these materials for their classrooms in ways that meet the particular requirements of the classrooms and ensure cultural relevance and resonance with content. In addition, the development of improvised materials fosters the interaction and practical learning method that makes students more connected to the concept being taught[19].

Most importantly, in developing countries with limited resources, improvised instructional materials serve as a more affordable means of learning due to their accessibility and availability. Teachers are able to overcome budgetary pressures by using improvisations of materials available within their immediate locale. This method fosters sustainability and enables educators to think ingeniously and hence come up with creative methods of imparting knowledge without relying on commercially prepared materials[19]. Even though improvised teaching/ learning materials are inexpensive and flexible, their effectiveness may rely on the ingenuity of the educator and also on resource availability as well as on their correspondence to educational objectives.

Essentially, the constant research and assessment regarding the effect that improvised materials could pose on students' academic achievement, as seen in this study, prove useful in our understanding of the function these materials carry in the process of teaching and learning[4].Improvised instructional materials are, therefore, dynamic, flexible modes of education that bank on resourcefulness and innovation for a better educational experience. These materials invite activity, accommodate different learning styles, and are a universally friendly mode of delivering lesson content[4]. The consideration of improvised instructional materials remains a valuable aspect in fostering effective and inclusive education as educators continue to grapple with evolving styles in methodologies.

By contrast, standardised instructional materials are commercially produced resources designed for educational uses. Typically, education experts, publishers, or curriculum developers with the intention of providing a uniform and structured approach in teaching any particular subject create these. Textbooks, multi-media presentations, e-learning modules, and laboratory packages are just a few forms of standardised materials offering a structured and detailed framework where the educational content is delivered[20]. In fact, consistency and reliability of standardised instructional materials is one of its major assets. These resources ensure that students learn a standardised and uniform education according to predetermined standards and policies, as the curriculum offered is the same[21].

The structure and presentation of standardised resources allow facilitators to cover step-by-step processes in dealing with specific areas, making it easier for learners to learn in a standardised and uniform manner irrespective of geographical location or learning institution. In most instances, facilitators use standardised learning resources concerning completeness of the materials. For example, textbooks are constructed in such a way that they can provide

unlimited scope of the curriculum through wide coverage of topics in a particular subject[22].Such wide scope of coverage may be advantageous in terms of providing students with an in-depth understanding of a particular subject and effectively preparing for standardised tests.

The use of standardised instructional materials can also promote equity in education. These learning materials have been deliberately developed to guarantee that every child, regardless of background or location, has the same level of exposure to knowledge through a common set of learning materials. This standardisation facilitates equity in the learning landscape through reduction in disparities of educational resources and opportunities[10]. However, critics contend that one-size-fits-all nature of standardised instructional materials can hardly accommodate the unique learning style and needs of students. Moreover, by nature, printed textbooks cannot keep pace with dynamic and rapidly changing information in some fields[23]. Understanding how standardised instructional materials are affecting academic achievement will have great implications for curriculum development and teaching strategies. The choice between standardised and improvised materials becomes a major concern[24]. Researching on the effects of these materials on the achievement of the students, one might wish to know which method is more superior than the other in enhancing a greater understanding and retaining information concerning the respiratory system.

There is a great need for instructional materials in Respiratory System teaching, as they permit visualization of the complex biological processes and reinforcement of theoretical knowledge hands-on. The effectiveness of instructional materials is related to their capacity to accommodate different learning styles and actively involve the students in learning processes[23]. On the other hand, the teaching aids used in delivering the lesson in the

Respiratory System in biology greatly influence the learning process of students. In any case, it is still the general effectiveness of lesson delivery whether in standardised or improvised materials which will determine student performance in the particular area in biology being studied[24]. Although there is a comprehensive literature on the use of instructional materials in biology education, few studies have concentrated their research effort to delve into issues relating to the respiratory system. However, upon further review, there are relevant findings that extend insight into the effects of instructional materials on academic performance in biology[25].

The complex and multi-layered nature of educational research into the role of gender in determining achievement outcomes of students in biology. In biology education, gender dynamics can impact and help shape differences in academic achievement, engagement, and self-concepts among students. Such influential factors include societal and cultural influences about gender roles and expectations that may affect the way students view science as a subject and biology as a discipline. Stereotypes and prejudices have fostered, over time, the notion that science, technology, engineering, and mathematics-related disciplines of which biology is one, are more applicable to males rather than females. Besides, the presence of differences in self-efficacy beliefs, learning styles, and preferences can lead to differences in performance in the biology subject[26].

Some research evidence has been presented indicating that in some areas, males and females are different in terms of their cognitive and behavioral performances. For instance, there is a suggestion that males perform in spatial reasoning, while females do well in collaborative learning situations and also in verbal performances. These differences in learning styles and preferences can influence the way students will engage with the material on the biology

curriculum, learning strategies, and assessment types, and consequently their performance in the subject becomes influenced. Moreover, teacher expectations, classroom environment, and relationships with peers may act as mediators of the influence of gender on students' Biology achievement. Sometimes unconsciously, gender stereotypes seep into the teaching methodologies and assessment practices of educators, thus shaping their perception about the capabilities and potentials of students. In this line, classroom settings that ensure learning environments are inclusive and nondiscriminatory-which minimise the impact of gender bias on academic performance-can further academic success for all students, regardless of their gender background[27].

This relationship between gender and academic achievement in biology is further complicated by the inter-sectionality of gender with other social identities, including race, ethnicity, socio-economic status, and cultural heritage. Intersecting barriers and systemic inequalities could reduce access to educational resources, mentorship opportunities, and positive learning experiences in biology for students from marginalised or underrepresented groups, thus heightening the impacts of gender bias. Any attempt to resolve the problem of gender inequality in the achievement record in biology must, therefore, be multilevel and inclusive enough to recognize the interaction of social, cultural, and institutional factors influencing the educational experiences of students. Evidence-based practices that could be used to promote gender equity in STEM subjects, creation of a motivating and inclusive learning environment, and challenging gender stereotypes and biases at the individual, institutional, and broader social levels. An enabling culture may be created by educators and stakeholders through inclusivity and diversity to allow all students to rise and flourish in the field of biology irrespective of their gender[28].

Taken together, these reports underscore the importance of high-quality instructional materials to enhance students' biological understanding, interest, and recall. Findings from these various broader studies are not consistent across the board. Several studies indicate that standardised instructional materials use, such as multimedia materials and textbooks, is positively related to improved academic achievement. These materials often are based on a systematic curriculum and represent more systematic comprehensive approaches to teaching biology[26, 27, 28].

Some studies counter the alternative approach: using improvising teaching tools. It elaborated the strengths of using locally relevant content, everyday examples, and activity-based learning. These learning materials were probably prepared by teachers or students to facilitate learners in better understanding certain concepts through the use of real life or hands-on purposes so that they can have a deeper and more meaningful insight from learning[29]. Instructional materials are thus relevant in the teaching-learning process; however, there is a noted lacuna in the related literature regarding their impact on students' academic achievement vis- a-vis the Respiratory System in biology. The research on the subject is either dealing with broad topics or tackling other sciences entirely.

The main intention of this study is to help educators, policymakers, and curriculum developers arrive at an understanding that is well-informed about what kind of instructional materials best improve student understanding and achievement in this specific area of biology. This means that the research brings out the need for instructional materials in biology learning. While general trends exist that indicate a positive correlation of academic achievement with certain categories of materials, the lack of specificity with regard to the respiratory system indicates a need for specific research in this area. This has thus formed the

basis for the present study to fill the gap and provide broader perspectives to assist teaching strategies and students' success in biology learning at senior secondary school level in Oyo town.

1.2 Statement of the Problem

Due to its complex anatomy structures and physiological functions, learning of the abstract conceptions of the respiratory systems in biology becomes complex for the students. The rather abstract nature of respiratory physiology, along with a general lack of interaction learning opportunities and hands-on experiences, impairs the students' ability to understand and retain key concepts. Furthermore, due to the limited availability of quality instructional materials, further support of learning is greatly restricted outside of the classroom, adding to the problem. Apart from this, the performance of students in the biology examinations, such as that conducted by WAEC, is partly affected by inconsistencies in their exposure to effective learning strategies, which is a consequence of the disparateness of teaching methodologies and instructional approaches among institutions in Oyo State.

This study has, therefore, looked into the effects of improvised and standardised instructional materials on the academic performance of senior secondary school students in Oyo town, Oyo State, as a means to address these challenges. The interventions must be holistic and

concentrated on improving the quality and availability of instructional materials through the provision of student-centered learning environments and equal opportunity for all students in Oyo State.

1.3 Aim and Objectives of the Study

The purpose of the study was to find out what effect standardised and improvised instructional materials have on the academic performance of senior school students in the field of biology, within the Oyo town, Oyo State.

Specifically, the objectives of this study are to:

i. determine the main effect of improvised instructional materials on the academic achievement of Senior Secondary School Biology students concerning topics on the respiratory system;

ii. determine the main effect of standardised instructional materials on the academic achievement of Senior Secondary School Biology students concerning topics on the respiratory system;

iii. examine the main effect of conventional method on the academic achievement of Senior Secondary School Biology students in respiratory system topics;

iv. examine the main effect of gender on the academic achievement of Senior Secondary School Biology students in respiratory system topics;

v. examine the interaction effect of improvised and standardised instructional materials on the academic achievement of Senior Secondary School Biology students as regarding respiratory system topics;

vi. examine the interaction effect of conventional method and improvised instructional materials on the academic achievement of Senior Secondary School Biology students with respect to respiratory system topics;

vii. examine the interaction effect of conventional method and standardised instructional materials on academic achievement of Senior Secondary School Biology Students on the topic of the respiratory system;

viii. examine the interaction effect of conventional method and gender on the academic achievement of Senior Secondary School Biology students in respiratory system topics;

ix. examine the interaction effect of conventional method, improvised instructional material and standardised instructional materials on the students' academic achievement in Senior Secondary School Biology on the concept of respiratory system topics;

x. examine the interaction effect of improvised instructional material, standardised instructional material and gender on students' academic achievement in Senior Secondary School Biology on the concept of respiratory system topics; and

xi. determine the interaction effect of conventional methods, improvised instructional materials, standardised instructional materials and gender on the academic achievement of senior secondary school Biology students.

1.4 Hypotheses

H_o1**:** There is no significant main effect of improvised instructional materials on academic achievement of Senior Secondary School Biology students in respiratory system topics;

H_o2**:** There is no significant main effect of standardised instructional materials on academic achievement of Senior Secondary School Biology students in respiratory system topics;

H_o3: There is no significant main effect of conventional method on academic achievement of Senior Secondary School Biology students in respiratory system topics;

H_o4: There is no significant main effect of gender on academic achievement of Senior Secondary School Biology students in respiratory system topics;

H_o5: There is no significant interaction effect of improvised and standardised instructional materials on academic achievement of Senior Secondary School Biology students in respiratory system topics;

H_o6: There is no significant interaction effect of conventional method and improvised instructional materials on academic achievement of Senior Secondary School Biology students in respiratory system topics;

H_o7**:** There is no significant interaction effect of conventional method and standardised instructional materials on academic achievement of Senior Secondary School Biology students in respiratory system topics;

H_o8: There is no significant interaction effect of conventional method and gender on academic achievement of Senior Secondary School Biology students in respiratory system topics;

H_o9: There is no significant interaction effect of conventional method, improvised instructional materials and standardised instructional materials on academic achievement of Senior Secondary School Biology students in respiratory system topics;

H_o10: There is no significant interaction effect of improvised instructional materials, standardised instructional materials and gender on academic achievement of Senior Secondary School Biology students in respiratory system topics; and

H_o11: There is no significant interaction effect of conventional method, improvised instructional materials, standardised instructional materials and gender on academic achievement of Senior Secondary School Biology students.

1.5 Significance of the Study

The research exploring the impact of improvised versus standardised instructional materials on the academic performance of senior secondary school students in the Respiratory System within biology in Oyo town holds significant importance on multiple levels. The findings from this study will contribute to a deeper understanding of biology education, particularly concerning the Respiratory System. By determining the effects of different instructional materials, the research aims to provide insights that can improve teaching strategies, curriculum development and educational policies in Oyo.

One key aspect of the study is its potential to enhance academic outcomes. Understanding the effectiveness of improvised and standardised materials in improving students' comprehension of the Respiratory System can help educators select the most beneficial resources. This knowledge could lead to more tailored and effective teaching approaches, ultimately boosting the academic performance of senior secondary students in biology.

The research is also significant for resource allocation and utilization. Like many regions, Oyo faces challenges related to limited educational resources. By determining the effectiveness of improvised instructional materials which are often more affordable and readily available the study may offer valuable insights for resource-constrained settings. If proven effective, improvised materials could serve as a viable alternative for delivering quality education where resources are scarce.

Additionally, the study contributes to advancing equity in education. It examines how instructional materials address diverse learning needs, seeking to identify strategies that foster inclusivity. This is particularly relevant in the Oyo town, where students come from varied backgrounds. The findings could support the development of a more equitable learning environment by highlighting how materials can be adapted to suit different learning styles and preferences.

The study's relevance also extends to the integration of educational technology. As digital resources become increasingly prevalent, understanding their impact on academics performance is crucial. The findings could inform decisions about the role of technology in biology education, ensuring that it enhances learning rather than exacerbating existing inequalities.

In summary, this research is poised to provide valuable insights into biology education, curriculum design, and educational policy in Oyo town. It focuses on key questions regarding the use of instructional materials in teaching the Respiratory System, aiming to improve educational quality, promote inclusivity, and guide educators and policymakers in creating more effective and equitable learning environments for senior school students.

1.6 Scope of the Study

The study is situated in Oyo town, located in Oyo State, Nigeria. The Oyo town consists of four Local Government Areas: Atiba, Oyo West, Oyo East and Afijio. This specific geographical focus allowed for a targeted examination of instructional materials in schools within this region. The study focused on students in Senior Secondary School Two (SS 2) in Oyo town. This group represents a critical stage in secondary education, where students are deeply engaged in core subjects like biology. The research aimed to analyse the academic performance of these students in relation to the use of instructional materials. The study centered on the topic of the Respiratory System in Biology. By narrowing the focus to this particular biological concept, the research can provide a more detailed and specific understanding of how instructional materials whether improvised or standardised affect students' comprehension and academic performance in this area.

1.7 Limitations to the Study

This study covered three Local governments Areas in Oyo town in Oyo State and this had limited the extent to which the study could be generalized. The content coverage was restricted to one topic in the aspect of biology, there is need for wider coverage of topic. In addition, only gender was considered among other moderating variables that could affect academic achievements. Another constraints was epileptic supply of electricity.

However and in spite of these limitations, the findings of this study were not jeopardized, they serves as a point of reference for further studies in the area of designing and utilization of instructional materials and students' academic achievements of any large class subjects offered in secondary schools.

1.8 Operational Definition of Terms

Instructional Materials These are broad spectrum of tools, resources, and aids meant to improve teaching and learning environments' processes. These carefully crafted resources let teachers present knowledge, show ideas, and include students in active learning opportunities across many disciplines and fields.

Improvised Instructional Materials: This study made use of locally produced instructional aids and tools like charts, diagrams, models, and hands-on activities created by teachers or students utilising easily accessible resources. Not developed for commercial use, the materials are meant to complement or improve the respiratory system education in biology. **Standardised Instructional Materials:** These are teaching tools for the Respiratory System in biology, such multimedia presentations and e-learning modules applied in this study, are commercially created educational resources meant for teaching. These resources are widely used in official educational settings and conform to accepted learning criteria. Students in Senior Secondary School: With specific attention on SS2, this study examines students registered in the class levels SS1 through SS3 in respiratory system. **Academic Achievement:** This captures the results of the tests given to students all during the course of their experiment.

Biology: The methodical study of living entities and their interactions with their surroundings is what is known as biology. With an eye on understanding the structure, function, and behavior of organisms at several levels of organisation, this field comprises many sub-disciplines including anatomy, physiology, genetics, ecology and evolution. **Respiratory system:** Mostly including the intake of oxygen and the release of carbon

dioxide, the respiratory system is the biological structure in charge of gas exchange in live entities. Within the discipline of biology, the respiratory system consists of organs and systems like the lungs, trachea, bronchi, and alveoli that allow the study's necessary respiratory gas exchange for cellular respiration.

Gender: This relates to male and female SS2 students attending the Oyo Metropolitan secondary schools.

Conventional Method of Teaching: The conventional strategy of instruction consists of widely used pedagogical techniques and typical instructional approaches in educational surroundings. This covers lectures, textbooks, rote memorization, and teacher-centered instruction in which case teachers impart knowledge to students in a passive sense. Many times, traditional teaching strategies are contrasted with creative and student-centered strategies stressing active learning, critical thinking, and group problem-solving.

Endnotes

1. K. Adeyemi & T. Adeyemi, *Teacher-Student Relationships and Academic Outcomes in Ogun State*, **Nigerian Journal of Educational Psychology**, 29(1), 2022, 56-72.

2. E. R. Green, J. S. Heyner & R. Kara, *Biology*, Encyclopedia Britannica. Available online: https://www.britannica.com/science/biology. 2023.

3. K. Oluwaseun, F. Adeola & E. Chidi, *Microbial Communities and Ecological Balance in Nigerian Ecosystems*, **Nigerian Journal of Microbial Ecology**, 19(2), 2021, 101-118.

4. J. Momsen, E. B. Speth, S. Wyse & T. Long, *Using Systems and Systems Thinking to Unify Biology Education,* CBE Life Sciences Education, 21(2), 2022. Available online: https://doi.org/10.1187/cbe.21-05-0118.

5. N. C. Kelp, M. McCartney, M. A. Sarvary J. F. Shaffer & M. J. Wolyniak, *Developing Science Literacy in Students and Society: Theory, Research, and Practice,* **Journal of Microbiology & Biology Education,** 24(2), 2023. Available online: https://doi.org/10.1128/jmbe.00058-23.

6. T. Ordoñez, S. Lorenzo, T. Ordoñez & M. Concepcion, *The Scope of Biotechnology in the 21st Century. Available Online:* file:///C:/Users/HomePC/Downloads/TheScopeof Biotechnologyinthe21stCentury.pdf. 2023.

7. D. Akinola & M. Dichaba, *Lifelong Learning and Career Progression of Women in Nigeria*. Available online: 10.1007/978-3-030-44217-0_18. 2021.

8. O. Damilola & O. Olaoye, *Paradigm Shift in Educational Assessment: Formative Assessment as a Pointer to Educational Reform in Nigeria School System,* **Lafiagi Journal of Science, Technical and Vocational Education,** 2(1), 2021, 91-106.

9. K. A. Powers & A. S. Dhamoon, *Physiology, Pulmonary Ventilation and Perfusion*, Treasure Island (FL). Available online: https://www.ncbi.nlm.nih.gov/books/NBK539907/, 2024.

10. T. Adebola, & K. Oladipo, *Effects of Urban Air Pollution on Asthma Prevalence and Severity in Children in Lagos.* **Nigerian Journal of Pediatric Health**, 14(3), 2022, 198-210.

11. A. Nicolò, C. Massaroni, E. Schena & M. Sacchetti, *The Importance of Respiratory Rate Monitoring: From Healthcare to Sport and Exercise, Sensors (Basel, Switzerland)*, *20*(21), 6396. Available online: https://doi.org/10.3390/s20216396. 2020.

12. D. K. Mokoro, *Adequacy of Laboratory Facilities for Effective Implementation of Competence-Based Curriculum in Public Secondary Schools in Arumeru District, Tanzania,* **East African Journal of Education and Social Sciences,** 1(2), 2020, 141-149.

13. M. Berhanu & H. Sheferaw, *The Effectiveness of Guided Inquiry-Based Learning Strategy on Learning Physical and Chemical Changes*, **African Journal of Chemical Education**, 12(2), 2022, 149 – 185.

14. M. Bello & S. Adeola, *Utilization of Multimedia Presentations in Teaching Complex Concepts in Tertiary Institutions in Ogun State*, **Nigerian Journal of Higher Education**, 21(1), 2023, 95-110.

15. O. A. Spinola, V. Garrido, M. M. Teixeira, C. Salles & A. E. Haddad, *Influence of Learning styles on Student Performance in Self-Instructional Courses,* National Library of Medicine Science, 18(7), 2023.

16. D. Lukman, *Instructional Materials, Teaching Methods and Students' Performance.* Available online: https://imperialwriters7.medium.com/instructional-materials-teaching-methods-and-students-performance-754e38d8709c. 2021.

17. H. Husman, *Effects of Physical and Virtual Laboratories on Learning Outcomes in Geography among Senior Secondary School Students in North Central Nigeria,* PhD Thesis, Department of Educational Technology, Federal University of Technology Minna**.** Available online:

http://repository.futminna.edu.ng:8080/jspui/bitstream/123456789/14529/1/PhD%20USMAN%20Hussaini.pdf 2021.

18. U. Ordu, *The Role of Teaching and Learning Aids/Methods in a Changing World*. *In New Challenges to Education: Lessons from Around the World, BCES Conference Books*. 19, edited by Bulgarian Comparative Education Society. Sofia: Bulgarian Comparative Education Society, 2021, ISSN 2534-8426 (online), ISBN 978-619-7326-11-6. 2021.

19. C. Drinko, *Benefits of Improvisation in the Classroom.* Available online: https://www.playyourwaysane.com/blog/benefits-of-improvisation-in-the-classroom. 2020.

20. C. Jeffrey, A. Mcduffie, C. Drake & J. Davis, *The Role of Instructional Materials in the Relationship between the Official Curriculum and the Enacted Curriculum. Mathematical Thinking and Learning 24*. Available online: https://doi.org/10.1080/10986065.2020.1855376. 2020.

21. A. Julius & K. Michelle, *Measuring Education System Coherence: Alignment of Curriculum Standards, Examinations, and Teacher Instruction in Tanzania and Uganda,* **International Journal of Educational Development,** 9(1), 2022.

22. M. D. Abdulrahaman, N. Faruk, A. A. Oloyede, N. T. Surajudeen-Bakinde, L. A. Olawoyin, O. V. Mejabi, Y. O. Imam-Fulani, A. O. Fahm & A. L. Azeez, *Multimedia Tools in the Teaching and Learning Processes: A Systematic Review,* **Heliyon,** 6(11)*,* 2020. Available online: e05312. https://doi.org/10.1016/j.heliyon.2020.e05312.

23. C. Okafor, *Challenges of Using Printed Textbooks in Rapidly Changing Fields: A Case Study of Information Technology and Environmental Science,* **Nigerian Journal of Educational Technology**, 15(2), 2021, 145-160.

24. B. A. Ezeliora, F. N. Ibe & O. M. Chukwunazo, *Comparative Effects of Teaching with Improvised Instructional Materials and Standard Instructional Materials on Secondary School Students' Academic Achievement In Chemistry,* **International Journal of Research in Education and Sustainable Development,** 1, 2021, 27-40.

25. A. Omoshola, A. Abidoye & O. Malik, *The Effect of Biology Teaching Materials on the Academic Performance of Senior Secondary School Students in Ilorin West, Ilorin, Kwara State*, **International Journal of Educational Innovation and Research,** 2(1), 2023, 142-150.

26. W. Asante, C. Ackah, & L. K. Frimpong, *Gender Differences in Academic Performance of Students Studying Science Technology Engineering and Mathematics (STEM) Subjects at the University of Ghana*, SN Social Sciences**,** 3(1), 2023, 12.

27. H. Cathy, S. Stijn, D. Nicolas, F. Lot, S. Arnaud & D. Wouter, *Interactions of Gender with Predictors of Academic Achievement,* Contemporary Educational Psychology**,** 74. 10.1016/j.cedpsych.2023.102186. 2023.

28. I. Nwosu, P. Eze & C. Obasi, *Impact of Ethnic and Cultural Background on Gender Disparities in Biology Achievement in Delta State,* **Nigerian Journal of Multicultural Education**, 17(2), 2021, 98-113.

29. E. S. Etop, S. G. Iboro & A. S. Obogo, *Influence of Locally Available Instructional Materials on Biology Students' Academic Achievement in Abak Local Government Area of Akwa ibom state, Nigeria*, **Global journal of educational research,** 22(1), 2023, 81-87.

Chapter Two
Literature Review

This chapter focuses on the reviewed literature under the following subheadings:

2.1 Conceptual Review

2.1.1 Academic Achievement

2.1.2 Instructional Materials

2.1.3 Improvised Instructional Materials

2.1.4 Standardised Instructional Materials

2.1.5 Conventional Teaching Materials

2.1.6 Gender

2.2 Theoretical Framework

2.2.1 Constructivist Theory

2.3 Review of Empirical Study

2.3.1 Conventional Method and Academic Achievement in Respiratory System in Biology

2.3.2 Improvised Instructional Materials and Academic Achievement in Respiratory System in Biology

2.3.3 Standardised Instructional Materials and Academic Achievement in Respiratory System in Biology

2.3.4 Gender and Academic Achievement in Respiratory System in Biology

2.4 Conceptual Model

2.5 Summary of Literature Reviewed

2.1 Conceptual Review

2.1.1 Academic Achievement

Academic achievement is a multifaceted concept that encompasses the academic, cognitive, and socio-emotional outcomes attained by students in the course of their educational experiences. At its core, academic achievement reflects the extent to which students acquire knowledge, skills, competencies, and dispositions that enable them to meet academic standards, fulfill learning objectives, and demonstrate proficiency in various subject areas and domains. While academic achievement traditionally focuses on content mastery and performance on standardised tests and assessments, the concept of students' academic achievement extends beyond test scores to include critical thinking abilities, problem-solving skills, creativity, communication skills, and socio-emotional competencies such as self-regulation, resilience, empathy, and collaboration.

The assessment of student achievement involves the systematic measurement and evaluation of students' progress, growth, and learning outcomes across different academic disciplines and domains. Assessment methods may include standardised tests, performance assessments, projects, presentations, portfolios, observations, and self-assessments. These assessment tools provide educators with valuable insights into students' strengths, weaknesses, learning styles, preferences, and areas for growth, enabling them to tailor instruction and support to meet individual learning needs and foster continuous improvement in student achievement[1].

Moreover, academic achievement is influenced by a myriad of internal and external factors that interact in complex ways to shape learning outcomes. Internal factors, such as students' motivation, engagement, self-efficacy, mindset, and metacognitive skills, play a

crucial role in determining academic success and achievement. Motivated and engaged students are more likely to demonstrate higher levels of achievement and persistence in their academic pursuits. Similarly, students who possess strong self-regulatory skills, including goal-setting, time management, study strategies, and self-reflection, are better equipped to manage academic challenges and achieve success in their learning endeavors.

External factors, including the quality of instruction, curriculum design, school climate, peer relationships, family support, and socio-economic background, also significantly impact students' achievement. Effective teaching practices that promote active learning, differentiation, personalized instruction, and formative assessment are essential for fostering student engagement, motivation, and achievement. Additionally, a well-designed curriculum that is aligned with standards, relevant to students' interests and experiences, and responsive to diverse learning needs, can enhance student learning outcomes and achievement[2].

Furthermore, family involvement and support play a critical role in shaping students' attitudes, behaviours, and academic outcomes. Parents and caregivers who actively support their children's education, provide encouragement, resources, and academic guidance, and establish high expectations for achievement, contribute positively to student motivation, engagement, and success. Conversely, factors such as poverty, socio-economic disadvantage, language barriers, inadequate resources, and lack of access to quality education can pose significant challenges to student achievement and exacerbate disparities in educational outcomes[3].

Several factors influence students' academic achievement in Biology, ranging from instructional strategies and classroom environments to individual characteristics and socio-

economic backgrounds. Effective teaching practices play a crucial role in promoting students' academic achievement in Biology. Teachers who utilize active learning strategies, inquiry-based instruction, hands-on activities, and real-world applications engage students in the learning process, fostering curiosity, critical thinking, and deeper understanding of biological concepts and phenomena. Additionally, providing opportunities for student collaboration, discussion, and exploration enhances engagement and promotes knowledge construction, retention, and transfer in Biology.

The design and delivery of the Biology curriculum also influence students' academic achievement. A well-designed curriculum that is aligned with standards, relevant to students' interests and experiences, and responsive to diverse learning needs supports student engagement, motivation, and learning outcomes. Integration of interdisciplinary connections, current scientific research, and real-life examples enriches the learning experience and makes biology content more meaningful and accessible to students. Moreover, incorporating technology-enhanced learning tools, multimedia resources, and digital simulations can enhance student engagement and facilitate inquiry-based learning experiences in biology[4].

Individual student characteristics, including motivation, interest, prior knowledge, and learning styles, impact students' academic achievement in biology. Motivated and curious students who have a genuine interest in biological phenomena are more likely to actively participate in learning activities, seek out additional resources, and persist in the face of challenges. Understanding students' prior knowledge, misconceptions, and learning preferences enables educators to tailor instruction, provide scaffolding and support, and promote conceptual understanding and mastery in Biology. Moreover, fostering a growth

mindset and promoting self-efficacy beliefs empower students to adopt positive attitudes towards learning and to persist in their efforts to achieve success in biology[5].

Socio-economic background and environmental factors also influence students' academic achievement in biology. Students from disadvantaged backgrounds may face barriers such as limited access to resources, inadequate support systems, and exposure to environmental stressors that impact their academic performance and engagement in biology. Providing equitable access to resources, support services, and opportunities for enrichment and academic advancement can mitigate the effects of socio-economic disparities and promote equitable outcomes in biology education. Moreover, creating a supportive and inclusive classroom environment that values diversity, promotes cultural responsiveness, and fosters a sense of belonging and acceptance enhances student engagement, motivation, and achievement in biology[6].

2.1.2 Instructional Materials

Instructional materials are essential tools used in educational settings to facilitate teaching and learning processes across various subjects and disciplines. These materials encompass a wide range of resources, including textbooks, workbooks, worksheets, multimedia presentations, educational games, simulations, and hands-on activities. Designed to support instructional objectives and enhance student engagement, instructional materials play a crucial role in conveying information, promoting understanding, and fostering active learning experiences.

One of the primary purposes of instructional materials is to present content in a structured and organized manner, making complex concepts and topics more accessible and

comprehensible to learners. Textbooks, for example, provide a systematic overview of subject matter, offering explanations, examples, illustrations, and exercises to reinforce learning objectives and facilitate knowledge acquisition. Similarly, multimedia presentations, interaction simulations, and educational videos leverage visual and auditory stimuli to enhance comprehension and retention of information, catering to diverse learning styles and preferences[7].

Instructional materials also serve as valuable resources for scaffolding learning experiences and providing opportunities for active participation and practice. Workbooks, worksheets, and hands-on activities offer opportunities for students to apply theoretical knowledge, engage in problem-solving tasks, and develop critical thinking and analytical skills. Educational games and simulations provide immersive learning experiences that promote exploration, experimentation, and discovery, fostering curiosity and creativity among learners. Moreover, instructional materials can be tailored to accommodate the diverse needs and interests of learners, including those with different learning styles, abilities, and backgrounds. By incorporating inclusive design principles and culturally responsive content, instructional materials can promote equity and accessibility in education, ensuring that all students have equitable access to high-quality learning resources and opportunities for academic success[8].

In addition to supporting student learning, instructional materials also play a significant role in supporting educators in their instructional planning, delivery, and assessment practices. Teachers rely on instructional materials to guide lesson planning, curriculum development, and assessment design, leveraging pre-designed resources and frameworks to streamline instructional processes and optimize teaching effectiveness.

Furthermore, instructional materials can facilitate formative and summative assessment practices, providing tools and guidelines for evaluating student progress, identifying learning gaps, and providing timely feedback to inform instructional decision-making[9].

Instructional materials are categorised into various types, each serving specific instructional purposes and catering to diverse learning needs and preferences. Textbooks are among the most traditional and widely used types of instructional materials in educational settings. Textbooks provide comprehensive coverage of subject matter, presenting content in a structured and organized format[10]. They often include explanations, examples, illustrations, and exercises to reinforce learning objectives and facilitate comprehension. Textbooks are valuable resources for both students and teachers, offering a systematic overview of topics and serving as reference materials for classroom instruction and independent study.

Workbooks and worksheets are supplementary instructional materials that provide opportunities for students to apply and practice what they have learned. Workbooks typically contain exercises, problems, and activities that reinforce key concepts and skills covered in textbooks or classroom instruction. Worksheets offer additional practice and assessment opportunities, allowing students to demonstrate their understanding and mastery of content through written or interaction tasks. Workbooks and worksheets can be used for homework assignments, in-class activities, or self-paced learning exercises, providing valuable opportunities for skill development and reinforcement[11].

Another type of instructional materials is multimedia presentations and digital resources. These have become increasingly prevalent in modern educational settings, offering dynamic and interaction learning experiences for students. Multimedia presentations leverage visual and auditory stimuli, such as slideshows, videos, animations, and audio recordings, to

enhance engagement, comprehension, and retention of information. Digital resources include online textbooks, e-books, interaction simulations, educational games, and virtual laboratories, which provide immersive and interaction learning experiences that cater to diverse learning styles and preferences. Multimedia presentations and digital resources offer flexibility and accessibility, enabling students to access learning materials anytime, anywhere, using digital devices such as computers, tablets, and smartphones[12].

Educational games and simulations are another types of instructional materials. They are innovative instructional materials that engage students in active learning experiences through gameplay and interaction scenarios. Educational games incorporate elements of competition, strategy, and problem-solving, challenging students to apply their knowledge and skills in a fun and engaging context. Simulations allow students to explore real-world phenomena, conduct experiments, and visualise abstract concepts in a virtual environment. Educational games and simulations promote experiential learning, critical thinking, and collaboration, fostering motivation and enthusiasm for learning among students[13].

Also, hands-on materials and manipulatives are types of instructional materials that are physical objects and tools used to facilitate hands-on learning experiences in subjects such as mathematics, science, and language arts. Examples include counters, blocks, models, maps, globes, and laboratory equipment. Hands-on materials provide tactile and kinesthetic experiences that complement theoretical knowledge, allowing students to explore, manipulate, and experiment with concepts in a concrete and tangible way. Hands-on activities promote active engagement, sensory integration, and problem-solving skills, enhancing understanding and retention of subject matter[14].

Instructional materials offer numerous benefits to both educators and learners alike. These resources provide structured and organized content that facilitates comprehension and retention of information, catering to diverse learning needs and preferences. Through textbooks, workbooks, multimedia presentations, and digital resources, instructional materials engage students in active learning experiences, promoting exploration, experimentation, and critical thinking. They serve as valuable tools for scaffolding learning experiences, providing opportunities for practice, application, and assessment. Moreover, instructional materials support educators in their instructional planning, delivery, and assessment practices, streamlining teaching processes and optimizing teaching effectiveness. By leveraging instructional materials, educators can create engaging and inclusive learning environments that foster student engagement, motivation, and academic achievement, ultimately empowering learners to succeed academically and thrive as lifelong learners[15].

2.1.3 Improvised Instructional Materials

Improvised instructional materials refers to the creation or adaptation of educational resources using locally available materials or resources to enhance teaching and learning experiences. Unlike traditional instructional materials, which are often commercially produced and standardised, improvised materials are developed using everyday objects, recycled materials, or locally sourced materials to meet specific instructional needs and contexts. One of the primary goals of improvised instructional materials is to address resource constraints and promote access to quality education in resource-limited settings, particularly in developing countries or underserved communities where access to commercial materials may be limited or prohibitively expensive[16].

Improvised instructional materials leverage the creativity, ingenuity, and resourcefulness of educators and community members to develop low-cost, contextually relevant resources that resonate with learners' experiences and cultural backgrounds. By utilising locally available materials such as paper, cardboard, wood, fabric, natural fibers, and recyclable items, educators can create hands-on, interaction learning materials that engage students and bring abstract concepts to life. For example, in mathematics education, educators may use bottle caps, beans, or sticks to teach counting, addition, subtraction, and other mathematical concepts through hands-on activities and manipulatives[16].

Moreover, improvised instructional materials promote experiential learning, critical thinking, problem-solving, and creativity among students by providing opportunities for active exploration, experimentation, and discovery. Through the process of creating and using improvised materials, students develop practical skills, spatial reasoning, and resourcefulness, fostering a deeper understanding and appreciation of the subject matter. For instance, in science education, students may construct models, conduct experiments, and explore scientific phenomena using locally available materials, fostering inquiry-based learning and scientific literacy[12].

Furthermore, improvised instructional materials can be tailored to address specific learning objectives, curriculum standards, and educational contexts, making them adaptable and flexible for diverse instructional needs. Educators can customize materials to suit the interests, learning styles, and developmental levels of students, ensuring that instruction is relevant, meaningful, and culturally responsive. Additionally, improvised materials can be easily modified or adapted based on feedback from students and educators, allowing for continuous improvement and innovation in teaching and learning practices[13].

Improvised instructional materials offer several distinct advantages in educational settings, providing educators and learners with unique opportunities for engagement, creativity, and resourcefulness. One significant advantage of improvised materials is their cost-effectiveness and accessibility. Unlike commercially produced materials, improvised resources are often made from readily available, low-cost materials that can be sourced locally or repurposed from everyday items[12]. This accessibility ensures that educators in resource-constrained environments have access to educational resources that support teaching and learning without imposing financial burdens or logistical constraints.

Furthermore, improvised instructional materials foster a sense of ownership, creativity, and collaboration among educators and learners. By involving students and community members in the creation and customization of instructional materials, educators empower learners to take an active role in their own education, fostering a sense of agency and investment in the learning process. The collaborative nature of improvisation encourages creativity, problem-solving, and innovation, as individuals work together to design, construct, and adapt materials that meet their specific instructional needs and learning goals[14].

Another advantage of improvised instructional materials is their adaptability and flexibility for diverse instructional contexts and learning environments. Unlike standardised materials, which may not always align with the cultural, linguistic, or educational backgrounds of learners, improvised materials can be tailored to reflect the unique experiences, interests, and perspectives of students. Educators can customize materials to incorporate local languages, cultural references, and real-world examples, making learning more relevant, meaningful, and engaging for learners[14].

Moreover, improvised instructional materials promote active learning, inquiry-based instruction, and hands-on experiences that enhance comprehension, retention, and application of knowledge. Through the use of manipulatives, models, simulations, and interaction activities, improvised materials provide students with opportunities to explore concepts, conduct experiments, and make connections between theoretical knowledge and real-world phenomena. This experiential learning approach encourages curiosity, critical thinking, and problem-solving skills, fostering deeper understanding and long-term retention of content[15].

In addition, improvised instructional materials contribute to environmental sustainability and promote eco-friendly practices in education. By repurposing recycled materials and reducing reliance on commercially produced resources, educators and learners minimise waste, conserve natural resources, and promote environmental stewardship. This eco-conscious approach not only benefits the planet but also instills values of sustainability and responsible consumption in students, preparing them to be conscientious global citizens[16].

While offering numerous benefits of improvised instructional materials, also present several challenges that educators must navigate to effectively integrate them into teaching and learning environments.

One significant challenge is the availability and consistency of resources. In many contexts, educators may face limited access to suitable materials and supplies, making it difficult to create and sustain improvised resources. Additionally, the quality and durability of improvised materials can vary widely, affecting their effectiveness and longevity in the classroom. Educators must carefully consider the availability and reliability of resources when planning and implementing improvised instructional materials to ensure continuity and effectiveness in instruction.

Another challenge of improvised instructional materials is the time and effort required for creation, adaptation, and maintenance[16]. Developing high-quality improvised resources demands considerable time, creativity, and expertise from educators, who must design materials that align with curriculum standards, learning objectives, and instructional goals. Furthermore, maintaining and updating improvised materials can be labor-intensive, requiring ongoing modifications, repairs, and replacements to address wear and tear and accommodate changes in instructional needs and contexts. Educators must be prepared to invest time and effort into the development and maintenance of improvised materials to ensure their effectiveness and relevance in the classroom[17].

Furthermore, improvised instructional materials may lack standardization and consistency across different educational settings and learning environments. Unlike commercially produced materials, which undergo rigorous review and validation processes, improvised resources may vary in quality, accuracy, and alignment with educational standards and best practices. This lack of standardization can pose challenges for educators in ensuring the reliability, credibility, and effectiveness of improvised materials, particularly when used to supplement or replace traditional instructional resources[13]. Educators must exercise caution and discernment when selecting and utilizing improvised materials to ensure that they meet educational objectives and support student learning effectively.

Moreover, the integration of improvised instructional materials into formal educational settings may encounter resistance or skepticism from stakeholders, including administrators, policymakers, parents, and community members. Traditional attitudes and perceptions about educational resources may contribute to skepticism or reluctance to embrace improvised materials, particularly if they are perceived as unconventional or

untested. Educators may face challenges in advocating for the value and effectiveness of improvised materials and securing support for their adoption and implementation in educational settings. Building consensus and fostering buy-in from stakeholders are essential for overcoming resistance and promoting the adoption of improvised instructional materials in schools and classrooms[18].

2.1.4 Standardised Instructional Materials

Standardised instructional materials refer to educational resources that are produced, distributed, and used on a widespread scale across educational institutions and settings. Unlike improvised materials, which are often created or adapted locally to address specific instructional needs and contexts, standardised materials are typically developed by educational publishers, curriculum developers, or government agencies and are designed to meet established curriculum standards, learning objectives, and educational requirements. Standardised instructional materials reflects a systematic approach to curriculum development and instructional design, aimed at ensuring consistency, coherence, and quality in educational content and delivery[19].

One key aspect of standardised instructional materials is their alignment with curriculum standards and learning objectives. Standardised materials are designed to cover specific content areas, topics, and skills outlined in educational standards and frameworks, ensuring that instruction is comprehensive, sequential, and aligned with established learning goals. By adhering to standardised guidelines and benchmarks, instructional materials help educators and students track progress, monitor achievement, and assess mastery of essential knowledge and competencies[19].

Another characteristic of standardised instructional materials is their accessibility and scalability across diverse educational contexts and learning environments. Standardised materials are produced in large quantities and made available to educators, schools, and districts through textbooks, workbooks, digital resources, and other formats. This accessibility ensures that educators have access to high-quality instructional materials that support teaching and learning across different subjects, grade levels, and instructional settings. Standardised materials also facilitate consistency and continuity in instruction, enabling educators to implement cohesive and coherent curriculum frameworks that promote educational equity and excellence[20].

Furthermore, standardised instructional materials undergo rigorous review, evaluation, and validation processes to ensure quality, accuracy, and effectiveness in supporting student learning. Educational publishers and developers invest significant resources in research, development, and testing to create materials that are pedagogically sound, engaging, and responsive to diverse learning needs and preferences[21]. Through field testing, expert review, and stakeholder feedback, standardised materials are refined and revised to meet the evolving needs of educators and students and to incorporate best practices in instructional design and pedagogy. Moreover, standardised instructional materials often incorporate supplementary resources and support materials, such as teacher guides, assessments, multimedia presentations, and professional development resources, to enhance implementation and support educators in effective instructional practices. These supplementary materials provide educators with guidance, strategies, and tools for planning, delivering, and assessing instruction, helping to maximise the impact of standardised materials on student learning outcomes[22].

Standardised instructional materials play a pivotal role in promoting consistency and quality in Biology instruction by providing educators with structured, comprehensive resources that align with curriculum standards and learning objectives. In Biology instruction, standardised materials serve as foundational resources that cover essential biological concepts, principles, and skills outlined in curriculum frameworks and standards. These materials offer educators a cohesive framework for organising instruction, ensuring that key topics are covered systematically and comprehensively across different grade levels and educational settings.

Moreover, standardised materials in Biology instruction help maintain consistency in content delivery and instructional practices[23]. By adhering to established curriculum standards and guidelines, educators can rely on standardised materials to ensure that instruction is aligned with educational objectives and expectations. Consistent use of standardised materials fosters coherence in curriculum implementation, promotes shared understandings among educators, and facilitates continuity in student learning experiences, regardless of variations in teaching styles, backgrounds, or instructional contexts[24].

Furthermore, standardised materials provide educators with validated and vetted resources that have undergone rigorous review and evaluation processes to ensure accuracy, relevance, and effectiveness in supporting student learning. In Biology instruction, where accuracy and currency of information are paramount, standardised materials serve as trusted sources of scientific content, helping educators convey accurate and up-to-date information to students. Additionally, standardised materials often incorporate evidence-based instructional strategies, pedagogical approaches, and assessment tools that reflect best practices in Biology education, enhancing the overall quality and effectiveness of instruction.

Standardised materials also promote equity and access in biology instruction by providing all students, regardless of socioeconomic status or geographic location, with equitable access to high-quality educational resources. By distributing standardised materials across educational institutions and districts, educators can ensure that all students have access to consistent, high-quality instructional materials that support their learning needs and promote academic success. This equitable access helps level the playing field for students from diverse backgrounds and ensures that all learners have the opportunity to engage with rigorous and relevant biology content[25].

Moreover, standardised materials in biology instruction offer support and guidance for educators in implementing effective instructional practices and assessments. Many standardised materials include supplementary resources, such as teacher guides, lesson plans, activities, and assessments that provide educators with valuable tools and strategies for planning, delivering, and assessing instruction. These resources help educators differentiate instruction, address diverse learning needs, and monitor student progress effectively, enhancing the overall quality and impact of biology instruction[26].

2.1.5 Conventional Teaching Method

The concept of conventional teaching methods refers to traditional approaches to education that have been prevalent for centuries. These methods typically involve face-to-face instruction in a classroom setting, with a teacher delivering lectures and students taking notes, participating in discussions, and completing assignments. Conventional teaching often relies heavily on textbooks and other printed materials as primary sources of information. In recent years, however, conventional teaching methods have come under scrutiny as educators and researchers explore alternative approaches to instruction. This shift has been driven by

advancements in technology, changes in student demographics and learning styles, and a growing body of research highlighting the limitations of traditional teaching methods.

According to a recent study, conventional teaching methods may not effectively engage students or accommodate diverse learning needs. The researchers argue that these methods often prioritize rote memorization over critical thinking and problem-solving skills, leading to surface-level understanding rather than deep learning outcomes[27]. Additionally, they suggest that conventional teaching may fail to foster creativity and innovation, which are increasingly valued in today's knowledge-based economy. Moreover, the COVID-19 pandemic has further underscored the need for educators to adapt their teaching methods to accommodate remote and hybrid learning environments. As noted, the sudden shift to online instruction forced many teachers to rethink their approaches to teaching and learning. While this transition presented numerous challenges, it also provided an opportunity for educators to explore new technologies and pedagogical strategies that could enhance student engagement and learning outcomes[28].

In response to these challenges, many educators are exploring innovative teaching methods such as flipped classrooms, project-based learning, and personalized instruction. These approaches aim to actively engage students in the learning process, encourage collaboration and inquiry, and provide opportunities for authentic, real-world learning experiences. For example, a study examined the effectiveness of project-based learning in enhancing students' critical thinking skills. The researchers found that students who participated in project-based learning activities demonstrated significantly higher levels of critical thinking than those in traditional classroom settings. This suggests that innovative teaching methods can have a positive impact on student learning outcomes[29].

2.1.6 Gender

Gender has undergone significant evolution in recent years, moving beyond traditional binary understandings to encompass a more nuanced and fluid understanding of identity. Gender is no longer viewed solely as a binary construct determined by biological sex but is recognized as a complex interplay of biological, social, cultural, and personal factors. This broader perspective acknowledges that gender identity exists on a spectrum, with individuals expressing a diverse range of identities beyond the categories of male and female. Recent research has highlighted the importance of recognizing and respecting diverse gender identities. For instance, a study found that individuals who identify as transgender or non-binary often face discrimination and marginalization in various domains, including education, employment, healthcare, and social settings. This underscores the need for greater awareness and understanding of gender diversity to promote inclusivity and reduce stigma and discrimination[30].

Furthermore, the concept of gender intersects with other social categories, such as race, ethnicity, sexual orientation, disability, and socioeconomic status, shaping individuals' experiences and opportunities. Intersectional perspectives emphasize the interconnectedness of these factors and their impact on individuals' identities and lived experiences. For example, research explored the intersection of gender and race in educational settings, highlighting how Black transgender students may face unique challenges and barriers compared to their white counterparts due to systemic racism and transphobia.

In response to these insights, there has been a growing recognition of the need for policies and practices that promote gender equity and inclusivity[31]. Educational institutions, workplaces, and healthcare providers are increasingly implementing policies to support

transgender and non-binary individuals, such as gender-affirming healthcare, inclusive language policies, and gender-neutral facilities. Moreover, advocacy efforts by LGBTQ+ activists and organizations have played a crucial role in raising awareness about gender diversity and advocating for the rights and dignity of transgender and non-binary individuals. For instance, campaigns like the "Trans Rights Are Human Rights" movement have helped to bring attention to issues such as legal recognition, healthcare access, and protection from discrimination based on gender identity.

2.2 Theoretical Review

2.2.1 Constructivist Theory

Constructivist theory posits that learning is an active, constructive process where individuals actively construct knowledge and meaning through their experiences, interactions, and reflections. At its core, constructivism emphasizes the idea that learners are not passive recipients of knowledge but rather active participants in their own learning journeys. According to this theory, learners actively engage with new information by integrating it with their existing knowledge, beliefs, and experiences to construct their understanding of the world. One of the key principles of constructivism is that learning is context-dependent and situated within social and cultural contexts. Learners construct knowledge by interacting with their environment, engaging in meaningful activities, and participating in social interactions with peers, teachers, and community members. Through collaborative dialogue, negotiation of meaning, and shared exploration, learners construct knowledge that is socially and culturally situated, reflecting the values, perspectives, and beliefs of their cultural contexts[32].

Furthermore, constructivist emphasizes the importance of learners' active involvement in the learning process. Rather than passively receiving information from teachers or instructional materials, learners actively construct knowledge through exploration, inquiry, experimentation, and problem-solving activities. By engaging in hands-on experiences, reflective thinking, and metacognitive strategies, learners develop deeper understandings of concepts and principles, fostering critical thinking skills, creativity, and autonomy in their learning[33]. Constructivist also highlights the role of teachers as facilitators and guides in the learning process. Instead of being the sole disseminators of knowledge, teachers serve as facilitators who scaffold learning experiences, pose thought-provoking questions, provide opportunities for exploration and discovery, and support students in making connections between their prior knowledge and new information. Teachers create environments that promote active engagement, collaboration, and inquiry, fostering a community of learners where students feel empowered to construct their understanding of the world[33].

Moreover, constructivist emphasizes the importance of authentic and meaningful learning experiences that are relevant to students' lives and interests. By connecting learning to real-world contexts, problems, and applications, educators can enhance students' motivation, engagement, and retention of knowledge. Authentic tasks and projects allow students to apply their knowledge in meaningful ways, solve complex problems, and make connections between theory and practice, fostering deeper levels of understanding and transfer of learning[34].

Constructivist theory presents several strengths that have contributed to its popularity and influence in education. One of its primary strengths lies in its emphasis on active

engagement and participation in the learning process. By promoting active construction of knowledge through hands-on experiences, problem-solving activities, and collaborative interactions, constructivism encourages learners to take ownership of their learning and develop deeper understandings of concepts and principles. This approach fosters critical thinking skills, creativity, and autonomy, preparing students to navigate complex challenges and thrive in diverse learning environments.

Furthermore, constructivist theory recognizes the social and cultural dimensions of learning, highlighting the importance of social interactions, collaboration, and shared experiences in knowledge construction. By situating learning within social and cultural contexts, constructivist acknowledges the diverse backgrounds, perspectives, and experiences of learners and emphasizes the value of collaborative dialogue, negotiation of meaning, and cultural responsiveness in the learning process. This aspect of constructivist promotes inclusivity, diversity, and equity in education, fostering a sense of belonging and empowerment among learners from different cultural and linguistic backgrounds.

Moreover, constructivist theory underscores the importance of meaningful and authentic learning experiences that are relevant to students' lives and interests. By connecting learning to real-world contexts, problems, and applications, constructivist promotes motivation, engagement, and retention of knowledge. Authentic tasks, projects, and problem-solving activities enable students to apply their knowledge in practical situations, develop transferable skills, and make connections between theory and practice, enhancing the overall quality and relevance of learning experiences.

However, constructivist theory also has several weaknesses and limitations that have been subject to criticism and debate within the field of education. One criticism is that

constructivism's emphasis on student-centered, inquiry-based approaches may not always align with the realities of classroom practice and the constraints of standardised curriculum and assessment requirements. Implementing constructivist principles effectively often requires significant time, resources, and support for teachers to design and facilitate meaningful learning experiences that meet the diverse needs of learners.

Additionally, constructivist's focus on individual sense-making and knowledge construction may overlook the importance of explicit instruction and direct guidance from teachers, particularly in domains where students lack foundational knowledge or conceptual understanding. Critics argue that constructivist's emphasis on discovery learning and inquiry-based approaches may not always be suitable for all learners or all subject areas, particularly in disciplines that require mastery of foundational concepts and skills before engaging in higher-order thinking activities. Furthermore, constructivist theory has been criticized for its relativistic view of knowledge, which suggests that knowledge is subjective and context-dependent. While constructivism acknowledges the importance of multiple perspectives and cultural diversity in learning, some critics argue that it may lead to skepticism about the existence of objective truths or universal principles, potentially undermining the pursuit of rigorous inquiry and intellectual rigor in education.

In the context of exploring the effects of improvised and standardised instructional materials on senior secondary school students' achievement in biology in Oyo town, Oyo State, constructivist theory offers valuable insights into the dynamics of teaching and learning. Constructivist emphasizes active engagement, collaboration, and the construction of knowledge through meaningful experiences, aligning closely with the objectives of the study. Firstly, constructivist underscores the importance of active participation and hands-on

experiences in the learning process. In the study, students' engagement with instructional materials, whether improvised or standardised, is crucial for constructing meaningful understandings of biological concepts. Both types of materials should encourage active exploration, inquiry, and problem-solving to promote deeper learning and achievement in Biology.

Also, constructivist theory emphasizes the social and cultural dimensions of learning. In Oyo town, Oyo State, where diverse cultural backgrounds and perspectives exist among students, it's essential to consider how instructional materials resonate with students' cultural contexts and experiences. Improvised materials, for instance, may incorporate local examples, languages, or cultural references that enhance relevance and cultural responsiveness, fostering a sense of connection and belonging among students. Furthermore, constructivist highlights the role of teachers as facilitators and guides in the learning process. Educators in Oyo town must effectively scaffold learning experiences, provide support, and facilitate meaningful interactions with instructional materials to promote students' construction of knowledge in Biology. Teachers' understanding of constructivist principles can inform their selection, adaptation, and implementation of instructional materials to create dynamic and interaction learning environments that promote achievement in biology.

Moreover, constructivist theory underscores the importance of authentic and relevant learning experiences. Both improvised and standardised instructional materials should be designed to connect biology concepts to real-world contexts, applications, and students' interests. By fostering relevance and authenticity, instructional materials can enhance students' motivation, engagement, and achievement in biology, aligning with the principles of constructivist pedagogy. In summary, constructivist theory provides a theoretical framework

for understanding the relationship between instructional materials and students' achievement in biology in Oyo town, Oyo State. By embracing constructivist principles, educators can design and implement instructional materials that promote active engagement, cultural responsiveness, teacher facilitation, and authentic learning experiences, ultimately fostering achievement and promoting meaningful learning outcomes in biology education.

2.3 Review of Empirical Studies

2.3.1 Conventional Method and Academic Achievement in Respiratory System in Biology

In a study conducted, the effect of inquiry method on the academic achievement of senior secondary school students in biology in Ondo State, Nigeria was examined. The research aimed to determine the effects of the inquiry method on the academic achievement of senior secondary school students in biology[35]. Employing a pre-test, post-test, control group quasi-experimental design, the study involved a total of four hundred and twenty students who were taught using either the inquiry method or conventional lecture method. To facilitate the research, three instruments were constructed: the Students Biology Achievement Test (SBAT), Teachers' Instructional Guide on Conventional Lecture Method (TIGCLM), and Teachers' Instructional Guide on Inquiry Method (TIGIM). The SBAT underwent validity and reliability checks and was deemed suitable for the study. The study formulated and addressed three hypotheses. Data analysis involved mean, standard deviation, t-test, Analysis of Covariance (ANCOVA), and Pearson correlation, with pre-test scores utilised as covariates.

Results indicated that the inquiry approach significantly enhanced students' comprehension of the cell concept compared to the lecture method. Furthermore, students exposed to the inquiry method achieved significantly better results when solving biology problems based on the cell concept. Gender was found to have no significant effect on students' achievement in biology problem-solving. In conclusion, the study found that the inquiry method of teaching yielded superior results compared to the conventional lecture method in terms of student achievement. Consequently, it was recommended that secondary schools promote the use of functional, activity-based instructional strategies such as the inquiry approach.

A study explores the effects of group investigation strategy on secondary school students' academic achievement in biology within the Kwali Educational Zone of FCT-Abuja[36]. The research design adopted was quasi-experimental, employing a pre-test and post-test control group approach. The study aimed to address two research questions and test two hypotheses. The population of interest consisted of 2147 SS II biology students, from which a sample size of 90 biology students was drawn. These students were selected from two senior secondary schools within the Kwali Educational Zone, Abuja. Forty-six students were randomly assigned to the experimental group, while forty-four were assigned to the control group. The primary instrument used for data collection was a 30-item Biology Achievement Test (BAT). Descriptive statistics were employed to address the research questions, while a t-test was utilised to test the hypotheses. The analysis revealed a significant difference between the mean achievement scores of the experimental group and the control group. However, there was no significant difference observed between the mean achievement scores of male and female students within the experimental group. These findings suggest that the Group Investigation Strategy has a measurable effect on students' academic achievement and is not

influenced by gender biases. Consequently, the study concludes that Group Investigation Strategy positively impacts students' academic performance and is equitable across genders. As a result, it is recommended that science teachers undergo regular seminars, workshops, and conferences to familiarize themselves with the group investigation strategy and be encouraged to implement it in their classrooms. This recommendation aims to enhance teaching effectiveness and ultimately improve student learning outcomes in biology.

A study determines the effects of simulation strategy on the interest and academic achievement of senior secondary II biology students in the Plateau Northern Senatorial Zone, Nigeria[37]. The research aimed to assess the impact of simulation strategy on the academic achievement of senior secondary school students studying Biology in the Plateau Northern Senatorial Zone, Nigeria. Two specific objectives and corresponding research questions were outlined, alongside the formulation and testing of two hypotheses at a significance level of .05. To achieve this, a quasi-experimental research design, specifically the pre-test-post-test non-equivalent control group design, was employed. The study's population comprised all 5130 SS II Biology students, with 2795 males and 2335 females. A sample size of 74 SS II Biology students was selected, with 44 students assigned to the experimental group (19 males and 25 females) and 30 students to the control group (17 males and 13 females). Data collection utilized the Human Circulatory System Achievement Test (HCSAT), developed and validated by the researcher. Research questions were addressed using mean and standard deviation, while hypotheses were tested using ANCOVA and ANOVA. The analysis revealed that the achievement mean scores of the experimental group exceeded those of the control group after treatment, indicating that simulation strategy enhanced students' achievement compared to traditional teaching methods in Biology. Based on these findings, the study

recommended the incorporation of simulation strategy in Biology teaching practices to enhance students' academic achievement. This suggests a potential avenue for improving learning outcomes in biology education within the context of the Plateau Northern Senatorial Zone, Nigeria.

A study titled evaluating the effect of students' academic achievement on identified difficult concepts in senior secondary school biology in Delta State, Nigeria[38]. The study aimed to examine the impact of students' academic performance on their ability to grasp challenging biology concepts. A quasi-experimental research design was employed, specifically a 2x2 factorial non-randomized pretest-posttest control group design. The sample included 160 male and female students drawn from intact classes in four coeducational schools located in urban and rural areas within the Delta Central Senatorial District. Purposive sampling was used to select the participants. The primary instrument for data collection was the Biology Achievement Test (BAT), developed by the researchers and validated by experts in the field. The reliability of the instrument was confirmed with a Kuder-Richardson formula 21 coefficient of 0.71. Data were analysed at a significance level of 0.05. Students were divided into two groups: the experimental group was taught using the concept-mapping method, while the control group was exposed to traditional teaching methods. The study focused on topics such as heredity, genetics, and ecology, which students identified as particularly difficult. The results revealed that while certain topics were perceived as challenging, factors such as gender (male or female) and school location (urban or rural) did not significantly influence students' ability to understand these topics. However, the concept-mapping method proved to be a more effective instructional strategy compared to traditional teaching approaches, as it enhanced students' comprehension of the difficult

topics. Based on these findings, the authors recommended the implementation of innovative teaching strategies like concept mapping in classrooms to improve students' academic performance. They emphasised the importance of adopting creative pedagogical techniques to address learning difficulties in biology and potentially other subjects. This study highlights the role of instructional methods in facilitating better understanding of complex academic concepts.

Enhancing Biology Students' Academic Achievement and Attitude Through Self-Regulated Learning Strategy in Senior Secondary Schools in Delta Central Senatorial District[39]. The research aimed to explore the effectiveness of self-regulated learning strategies in improving students' academic achievement and attitudes toward biology. The study utilised a quasi-experimental pre-test, post-test control group design, guided by four research questions and four hypotheses. The study population included all Senior Secondary School II (SS II) biology students from government-owned public secondary schools in Delta Central Senatorial District, comprising an estimated 6,421 students. From this population, a sample of 245 students was randomly selected from four public coeducational secondary schools using a simple random sampling technique. Data collection instruments included the Biology Achievement Test (BAT) and the Biology Attitude Questionnaire (BAQ). These instruments were validated by experts in Measurement and Evaluation and experienced biology teachers with over ten years of teaching experience. Reliability coefficients were established using Kuder-Richardson formula 21 for the BAT (0.75) and Cronbac's Alpha for the BAQ (0.80), ensuring high internal consistency. Pre-test and post-test data were collected using the BAT and BAQ. Statistical analyses, including mean, standard deviation, Analysis of Variance (ANOVA), and Analysis of Covariance (ANCOVA), were employed to evaluate

the data. Results revealed that the self-regulated learning strategy significantly enhanced students' academic achievement in biology compared to traditional lecture methods. Furthermore, no significant gender differences were observed in academic achievement or attitudes among students taught using the self-regulated learning strategy. However, a significant improvement in students' attitudes was recorded for those taught with the self-regulated learning strategy compared to the lecture method, favoring the experimental group. The study concluded that self-regulated learning strategies effectively enhance both academic achievement and attitudes in biology. Based on these findings, it was recommended that biology teachers incorporate self-regulated learning strategies into their teaching practices. Additionally, professional development programs should be implemented to train biology teachers on the effective application of self-regulated learning techniques in secondary schools. This research underscores the potential of innovative instructional methods in fostering better academic outcomes and positive learning attitudes among students.

2.3.2 Improvised Instructional Materials and Academic Achievement in Respiratory System in Biology

A study explores the effect of improvised instructional materials on biology practical skills acquisition in senior secondary schools in Lagos State[40]. The research aimed to assess the impact of improvised instructional materials on the acquisition of biology practical skills among senior secondary school students in Lagos State. Two hypotheses were formulated to guide the study, focusing on the potential differences in achievement between male and female students and the effectiveness of improvised materials compared to traditional lecture methods. The population under investigation consisted of all biology students in public secondary schools within Education District VI, Lagos State. Utilising simple stratified

random sampling, a sample of two hundred SS II students was selected from Education District II, comprising 98 males and 102 females. The study adopted a pretest-posttest control group design, with 200 students forming the sample. Employing a quasi-experimental research design, the study utilized the biology practical skills achievement Test (BPSAT) (with a reliability coefficient of r=0.7) as the primary instrument for data collection. Analysis of the collected data was conducted using the t-test. Results indicated no significant difference in pretest and posttest scores between male and female students taught with improvised instructional materials. However, a significant difference was observed between pre-biology and post-biology skill scores of students taught using improvised materials compared to the lecture method. This finding suggests a substantial improvement in students' practical skills through the use of improvised instructional materials.

A study aimed at analysing the effect of science instructional materials on students' academic performance in Ilorin West, Kwara State[41]. The research sought to address three specific research questions and tested two hypotheses related to the impact of science instructional materials on students' academic achievement. It employed a descriptive research design of the survey type, targeting science students across various schools in Ilorin West, Kwara State, Nigeria. Using a random sampling technique, 120 science students were selected from different schools within Ilorin West Local Government Area, Kwara State, Nigeria. Data collection involved the administration of a research-designed questionnaire to gather information on class size, school type, and academic performance from the respondents. The accumulated data were subjected to analysis using frequency count and percentage, mean, and standard deviation. Furthermore, the research hypotheses were analysed employing an independent t-test and ANOVA to explore the relationship between

science instructional materials and students' academic performance. The study's findings revealed a significant positive effect of science instructional materials on the academic performance of students across various schools. Students who were taught using science instructional materials demonstrated superior academic performance compared to those who were not. Additionally, there was a notable effect based on school type, while no significant effect was observed based on class size. Based on these results, recommendations were made, suggesting that the Ministry of Education take proactive measures to ensure the provision of science instructional materials to schools across the state. This initiative is expected to contribute to improved performance in science subjects among students in Kwara State. As a recommendation, the study suggested that biology teachers should consistently improvise instructional materials when necessary and actively involve students in the production of these materials to enhance the teaching and learning of biology in schools. This approach fosters student engagement and facilitates a deeper understanding of practical concepts in biology education.

A study investigates the effects of improvised instructional media on Niger State secondary school students' achievement in selected biology concepts[42]. The research aimed to explore the impact of improvised instructional media on secondary school students' achievement in biology within Niger State. Additionally, it sought to examine the effects of gender and ability levels on achievement in this context. A total of 270 students were selected from nine public senior secondary schools in the state. The study adopted a pretest-posttest control group factorial design, with the treatment involving three groups: experimental group 1 taught with improvised models, experimental group 2 taught using a developed video DVD instructional package, and a control group taught through traditional lecture methods. Data

collection was facilitated through a 40-item Structured Biology Achievement Test (SBAT), which was developed and validated for this study, achieving a reliability coefficient of 0.83. Seven hypotheses were formulated and tested at a significance level of 0.05, with ANOVA Statistic utilized for hypothesis testing. Scheffe's post hoc test was employed where significant differences existed among more than two groups. The findings of the study revealed significant differences between the experimental groups (1 and 2) and the control group, indicating higher achievement among students taught with improvised models and video DVD instructional packages compared to traditional lecture methods. Furthermore, significant differences were observed between male and female experimental groups and their respective control groups, as well as among students of different ability levels across the experimental and control groups. Based on these findings, the study recommended the full encouragement of using improvised instructional media in the absence of conventional resources. It suggested that teachers of Biology and other science subjects could effectively utilize improvised models or video DVD packages to enhance teaching and learning outcomes in secondary schools.

A research on effect of improvised instructional materials on senior secondary school students achievement and retention in Mathematics[43]. The research investigated the impact of improvised instructional materials on the academic performance and retention of mathematics concepts among senior secondary school students. Conducted in the Ngor-Okpala Local Government Area of Imo State, Nigeria, the study employed a quasi-experimental design, specifically the pre-test post-test non-equivalent control group design. A sample of 243 senior secondary school II (SSII) students participated in the study. Data collection utilized a mathematics achievement test (MAT) instrument developed by the

researcher, with a reliability coefficient of 0.84 as determined by the Kuder-Richardson formula (KR-20). The experimental group received instruction in mathematics using improvised instructional materials, while the control group received traditional instruction. Data analysis was conducted using ANCOVA and t-test statistical methods, with significance tested at the 0.05 level. Results indicated that the use of improvised instructional materials led to improvements in students' academic achievement in mathematics and facilitated better retention of knowledge among students. Based on these findings, it is recommended that mathematics educators consider integrating improvised instructional materials into their teaching practices, particularly in situations where standard resources are limited or unavailable. Doing so may enhance students' achievement in mathematics and contribute to a deeper understanding of the subject matter.

A study on effect of improvised instructional materials on academic achievement of SS1 chemistry students in Cross River State Nigeria[44]. The study aimed to explore the impact of instructional materials on the academic achievement of SS1 chemistry students in Cross River State, Nigeria. Two hypotheses were formulated to guide the study, employing an experimental research design. The population comprised all chemistry students in the 17 secondary schools within Calabar Municipality, with a sample size of 100 SS1 chemistry students selected for the study. Data collection utilized the Chemistry Achievement Test (CAT), developed by the researcher, which demonstrated good internal consistency with a reliability coefficient of 0.79, as determined by Pearson product moment correlation. The high reliability coefficient indicated the instrument's reliability. Descriptive statistics and analysis of covariance (ANCOVA) were employed to analyze the data collected through the CAT instrument, with a significance level of 0.05 utilized in testing the study's hypotheses.

Results revealed that students taught Acids and Bases using improvised materials performed better academically compared to those taught without such materials. However, there was no significant gender effect observed when students were taught using improvised instructional materials. Based on these findings, recommendations were made to enhance teaching and learning practices in chemistry. These include providing training for teachers on improvisation techniques to supplement real objects, ensuring the relevance of instructional materials to lesson content, actively involving learners in material sourcing, and encouraging financial contributions from government bodies, non-governmental organizations (NGOs), and Parent-Teacher Associations (PTAs) to support the promotion of improvisational instructional materials in secondary schools.

A study on the effect of Improvised Instructional Materials on Students' Achievement and Interest in Longitude and Latitude[45]. The study aimed to explore the impact of improvised instructional materials on students' achievement and interest in Longitude and Latitude, with consideration given to the influence of gender. Four research questions and six null hypotheses were formulated to guide the investigation. Employing a non-equivalent control group quasi-experimental design, two schools were randomly selected from Olamaboro Local Government Area of Kogi State, Nigeria, with one school assigned to the control group and the other to the experimental group. Intact classes from each school were utilized for the study. Two instruments, namely the Longitude and Latitude Achievement Test (LLAT) and the Longitude and Latitude Interest Scale (LLIS), were employed for data collection. Mean and standard deviation were utilized to address the research questions, while analysis of covariance (ANCOVA) was employed to test the hypotheses. The findings of the study indicated that the use of improvised instructional materials, specifically the

Frame of a Sphere, led to increased student achievement and interest in Longitude and Latitude. Consequently, it was recommended that mathematics teachers should integrate improvised instructional materials into their teaching practices, as this has been shown to enhance both student achievement and interest in the subject.

A study on the Effect of Improvised Instructional Materials on Senior Secondary School Students' Achievement in Biology in Enugu South Local Government Area of Enugu State, Nigeria[46]. The research investigated the impact of using improvised instructional materials on the academic performance of senior secondary school biology students. The study was guided by three research questions and three hypotheses. A quasi-experimental design was employed, involving 100 senior secondary school students as participants. The instrument for data collection was the Biology Achievement Test (BAT), which was face- and content-validated to ensure its appropriateness for the study. The reliability of the instrument was determined using the Kuder-Richardson formula-20 (K-R 20), yielding a coefficient of 0.83, indicating high reliability. Data were analyzed using mean for descriptive purposes, and hypotheses were tested at a 0.05 level of significance using Analysis of Covariance (ANCOVA). The findings revealed that students taught with improvised instructional materials performed significantly better in biology than those taught without such materials. This result highlights the effectiveness of utilizing locally sourced and creatively designed teaching aids in enhancing students' understanding of biology concepts. Based on these findings biology teachers should incorporate improvised instructional materials into their teaching practices. This approach would help bridge gaps in resource availability and provide students with a better understanding of biological concepts by

utilizing materials from their immediate environment. The study underscores the importance of resourcefulness and innovation in teaching strategies to improve student achievement.

2.3.3 Standardised Instructional Materials and Academic Achievement in Respiratory System in Biology

Investigation on the impact of instructional materials on students' academic performance regarding the respiratory system concept[47]. To guide the research, three research questions and three null hypotheses were formulated. Employing a quasi-experimental design, the study focused on a population of 3135 senior secondary two (SS2) biology students across fourteen public secondary schools in Itu Local Government Area. Utilizing a sample size of one hundred students, selected from two public secondary schools through simple random sampling, Biology Achievement Test (BAT) served as the primary data collection instrument. The reliability coefficient of 0.80, established via Pearson Product Moment Correlation, ensured the instrument's consistency. Analysis of the collected data involved employing mean, standard deviation, and independent t-test statistics.

The findings revealed a significant disparity in academic performance between students taught the respiratory system using instructional models and those taught using still pictures. However, no significant discrepancy was observed in the academic achievements of male and female students instructed through models versus still pictures in biology. In light of these results, it is recommended that biology educators integrate instructional models into their lesson delivery methods to potentially enhance students' performance in biology. This suggestion underscores the importance of employing varied instructional materials to cater to diverse learning styles and optimise academic outcomes.

An examination on the impact of instructional materials on students' academic performance in biology within the Calabar South Local Government Area, Cross River State[48]. The independent variables under examination included the availability, accessibility, and utilisation of instructional materials, while the dependent variable was students' academic performance in biology. To guide the study, three research questions and three hypotheses were formulated. A review of relevant literature was conducted focusing on the variables of interest.

The research design chosen for this study was Ex-post facto design. Two hundred SS2 students from public secondary schools were randomly selected to participate. Data collection was carried out using a 15-item questionnaire titled "Influence of Instructional Materials on Students' Academic Performance in Biology Questionnaire (IISAPB)," developed by the researcher. Statistical analysis was performed using the Pearson Product Moment Correlation Coefficient test statistic, with each hypothesis tested at a significance level of 0.05.

The findings of the study indicated a significant relationship between the availability, accessibility, and utilisation of instructional materials and students' academic performance in biology among SS2 students in the Calabar South Local Government Area of Cross River State. Based on these findings, recommendations were made, including the importance of fostering positive attitudes among teachers towards the use of instructional materials to enhance student proficiency.

The relationship between instructional materials and students' academic performance in senior secondary schools within Osun State[49]. A sample of 40 students was randomly selected from two secondary schools in Ilesa East Local Government area, with 20 students

allocated to an experimental group and 20 to a control group. The research employed quantitative methods, utilizing formulated research questions and hypotheses to guide data collection. The research instrument used was a Biology Achievement Test (BAT) consisting of 50 multiple-choice items. The BAT demonstrated a reliability coefficient of 0.82, as determined through the Test-retest method. Data analysis involved the utilisation of mean score, standard deviation, and T-test distribution. The findings indicated that students who were taught with instructional materials performed better academically compared to those who were not. Specifically, the experimental group outperformed the control group, as evidenced by the calculated t-value of 3.94 surpassing the critical t-value of 2.02. Additionally, it was found that there was no significant difference between the pre-test and post-test scores of the experimental group, suggesting that the instructional materials facilitated consistent academic performance.

Further analysis revealed no significant discrepancy between the post-test scores of male and female students who were taught with instructional materials, indicating that gender did not influence the effectiveness of the instructional approach (t-critical value, 2.10 > t-calculated value, 1.33). Based on these findings, several recommendations were proposed to enhance academic performance in Senior Secondary Schools.

A study titled effect of biology teaching materials on the academic performance of senior secondary school students in Ilorin West, Ilorin, Kwara State[23]. This research investigated the role of instructional materials in enhancing the academic performance of senior secondary school Biology students, emphasizing their relevance in modern pedagogical practices. The study employed a descriptive survey research design, targeting biology students in senior secondary schools within Ilorin West Local Government Area,

Kwara State. A random sampling technique was used to select a sample of 120 students. Data were collected through a structured questionnaire and analysed using statistical methods such as frequency count, percentage, mean, standard deviation, independent t-tests, and ANOVA to identify significant trends and differences. The findings revealed that biology instructional materials had a significant positive effect on students' academic performance. Students taught using these materials achieved higher scores compared to their counterparts who were not exposed to them. Interestingly, the study found no significant differences in performance based on gender or class size, suggesting that instructional materials benefit a diverse student population uniformly. Additionally, the study highlighted the importance of school type, noting that access to instructional materials had a notable impact on academic outcomes in both public and private schools. Based on these findings, several recommendations were made. The Ministry of Education should ensure that adequate instructional materials are provided to schools and biology teachers are encouraged to integrate these materials into their lessons to foster improved student engagement and competition. Furthermore, the government was urged to support public schools in acquiring necessary instructional resources and upgrading infrastructure such as classrooms and laboratories. This study underscores the critical role of

instructional materials in advancing academic performance and calls for concerted efforts to enhance their availability and usage in schools.

2.3.4 Gender and Academic Achievement in Respiration System in Biology

A study focusing on the improvisation of instructional materials for effective teaching and learning of computer education in junior secondary schools in Ebonyi State[50]. Specifically, the research investigated the extent to which instructional materials were

improvised for computer education in the Enugu North Local Government Area. The study employed a survey research design, with a sample comprising 18 computer science teachers from junior secondary schools in Enugu North. Data collection utilised a questionnaire containing seven items designed for teachers, addressing the improvisation of instructional materials. Research questions were analysed using mean scores. The findings revealed that while software components of computers were improvised to a low extent, hardware components were partially improvised to both a significant and minimal extent. Similarly, basic computer accessories were partially improvised to varying degrees. The study highlighted the crucial role of instructional materials in fostering student interest, retention, and transfer of learning in computer education within junior secondary schools. It emphasised that in the absence of adequate instructional materials, students' engagement and learning outcomes may be compromised. Notably, the study suggested that basic components could be improvised by teachers, students, or local carpenters using resources readily available within the learning environment. Furthermore, the research underscored the significance of improvised materials in developing both science attitudinal skills and practical competencies necessary for effective societal functioning. As a recommendation, the study proposed that the government organize seminars, workshops, and conferences on improvisation to empower teachers with the necessary skills to improvise instructional materials for computer education when standard equipment is unavailable. Such initiatives aim to enhance teacher resourcefulness and facilitate effective teaching practices in computer education, ultimately improving learning outcomes for students.

A study aimed at evaluating the impact of teaching aids on students' performance in Biology subjects within O'level secondary schools situated in Kayonza District[51]. The study

sought to assess the effectiveness of teaching aids in enhancing academic achievement among students in this specific educational context. Through convenient sampling, four schools were selected, encompassing a total population of 347 individuals, including four Deans of Studies, four Biology teachers, and 339 students. Data collection employed a mixed-method approach, incorporating interviews, observation checklists, and tests. Descriptive statistics, content analysis, and t-tests using SPSS 26 were utilised for data analysis, facilitating a comparison between students taught using teaching aids and those who were not. The findings indicated that textbooks and charts were the most readily available teaching aids, highlighting their prevalence in the educational environment. However, the study identified several challenges hindering the effective utilisation of teaching aids in biology teaching, notably including a lack of time to prepare teaching aids and language barriers associated with the materials. Despite these challenges, significant differences in academic performance were observed between students who learned with teaching aids and those who did not. Specifically, students taught with teaching aids exhibited higher mean scores compared to their counterparts who learned without such aids. In light of these findings, the study recommended various strategies to enhance the provision and utilization of instructional materials in O'level Biology education within Kayonza District. These recommendations encompassed initiatives such as organizing workshops for teachers on instructional materials usage, producing simple teaching aids through improvisation for student practice, and implementing effective supervision mechanisms to ensure the optimal utilization of available resources. By implementing these recommendations, the study suggests that O'level Biology education in Kayonza District can achieve improved academic performance outcomes.

A study explores the perceived influence of learning resources availability and utilization on senior secondary school students' performance in biology within the Ilorin metropolis[52]. The research formulated three research questions to guide its investigation. Employing a descriptive design of cross-sectional survey, the study targeted all Senior Secondary School Two (SSSII) students aged between 14 and 18 years in both public and private secondary schools across Ilorin Metropolis, Kwara State. A total of 150 students were purposively selected to participate in the study.

Data collection utilised the "availability and utilisation of learning resources on student performance questionnaire (AULRSPQ)" as the research instrument. The collected data underwent analysis using percentages. The findings of the study revealed a significant deficiency in the availability of required learning resources within secondary schools. Consequently, these resources remained largely unused by students, particularly in the field of science. The inadequacy of learning resources was identified as a significant hindrance to effective Biology education, leading to subpar academic performance among students. In light of these findings, the study put forth recommendations aimed at addressing the identified challenges. Specifically, it advocated for government intervention to ensure the adequacy of learning resources, such as textbooks, libraries, and laboratories, across all categories of secondary schools. By bolstering the availability of these essential resources, the study suggests that educational institutions can enhance the quality of Biology education, thereby improving academic performance outcomes among students.

A study carried out on the impact of improvised instructional materials on the academic performance of senior secondary students in mathematics within Oshimili South Local Government Area of Delta State. Employing a quasi-experimental pre-test, post-test

control group design, the study posed two research questions and tested two hypotheses at a significance level of 0.05. The population comprised 1,350 SS2 students from 12 public secondary schools in Oshimili South, while the sample included 68 SS2 students selected from two of these schools using intact class sampling. Simple random sampling was employed to select the two schools, from which intact classes were chosen. Data was collected using the Mathematics Achievement Test (MAT), and analysis involved mean calculation for the research questions and t-tests for the hypotheses. The findings revealed that students instructed with improvised instructional materials demonstrated improved academic achievement in Mathematics. Furthermore, the study concluded that gender did not exert a significant effect on the academic performance of students instructed in Mathematics using improvised materials. In light of these results, it was recommended that Mathematics educators should consider improvising instructional materials to enhance teaching and learning experiences in secondary schools[9].

Also, another study carried out on the impact of improvised instructional materials on the academic performance and interest in Mathematics among senior secondary school students in Enugu East local government area of Enugu state. Employing a quasi-experimental pre-test, post-test control group design, the study engaged a sample of 78 students selected from a population of 1650 attending public secondary schools in the specified area. Data collection utilized Mathematics achievement tests (MAT) and Mathematics Interest Inventory (MII), validated by three experts in measurement and evaluation and Mathematics education from Godfrey Okoye University Enugu. Reliability testing yielded a coefficient of 0.75 for MAT using Kudar-Richardson 20 (KR20) and 0.65 for MII using Cronbach's Alpha formula. Statistical analysis involved means, standard

deviations, and t-tests to examine hypotheses. Results indicated that students taught Mathematics with improvised instructional materials exhibited significantly higher academic achievement and interest levels compared to those taught with conventional methods. Recommendations included encouraging Mathematics teachers to proactively integrate improvised instructional materials into their teaching practices[53].

In addendum, a study was carried out on effect of instructional materials on Biology instructions among high achieving secondary school students in Sped International secondary school, Oyo, Nigeria. In the study, it was affirmed that biology, as a fundamental branch of science, plays a crucial role in shaping various fields of learning and contributing significantly to a nation's technological advancement. This study aimed to investigate the impact of instructional materials on biology instruction among high-achieving secondary school students at SPED International Secondary School in Oyo. Utilizing a quantitative research approach, the study employed a quasi-experimental design to test two hypotheses at a significance level of 0.05. Twenty samples were randomly selected from a population of 30 students who met the selection criteria. A 20-item Biology Achievement Test, with reliability and validity coefficients of 0.93 and 0.78, respectively, was administered. Pretest and post-test scores were analyzed using t-test statistics. The results indicated that the mean pre-test and post-test scores did not exhibit significant differences (p-values > 0.05), suggesting that instructional materials had no discernible effect on the biology achievement of the sampled high-achieving secondary school students. However, gender emerged as a significant predictor of academic achievement in Biology, with male and female students demonstrating divergent outcomes (p-values < 0.05). Despite these findings, the study recommended the consistent use of instructional materials by teachers for biology instruction due to its

potential to enhance students' achievement, although this may not necessarily apply to high-achieving secondary school students. Nevertheless, the study underscored the importance of ensuring adequate provision of instructional materials for every subject in both public and private schools. This recommendation reflects the broader goal of promoting effective teaching practices and optimizing learning outcomes across educational settings. By equipping teachers with the necessary resources, schools can create conducive learning environments that cater to the diverse needs and abilities of students, ultimately fostering academic excellence and holistic development[54].

The research conducted on the Effect of Gender on the Academic Achievement of senior secondary school Biology students who attend extra-mural classes (EMCs) in public schools[55]. The study employed a descriptive survey design. The population consisted of Biology students from 13 government-owned secondary schools in Esan Central Local Government Area, Edo State. A sample of 180 students was drawn using stratified sampling, dividing the schools into two groups: those that conduct biology EMCs and those that do not. Data were collected using a structured achievement test with a reliability coefficient of 0.83. Descriptive statistics, including frequency counts, means, and percentages, were used to answer the research questions, while ANOVA was used to test the hypothesis at a 0.05 significance level. The findings revealed that Biology EMCs were not widely offered, with only 15.38% of schools conducting these classes. Students who attended Biology EMCs performed significantly better than those who did not. Moreover, a statistically significant difference ($p < 0.05$) was observed in the performance of male and female students who attended Biology EMCs, with male students outperforming their female counterparts. Based on the findings, the study recommended that governments and educational stakeholders

promote and support the organization of EMCs for students. Adequate supervision should be provided to ensure these classes are conducted effectively and without misuse. Additionally, female students should be encouraged to adopt more positive attitudes and develop greater enthusiasm and self-efficacy in science subjects to enhance their academic performance. This study highlights the importance of targeted interventions to address gender disparities and improve academic outcomes in science education.

A study titled Influence of Gender on Students' Performance in Biology when Taught Reproduction Using Collaborative Strategy in Secondary Schools in Rivers State[56]. The research investigated how gender influences the academic performance of secondary school students in biology when taught the topic of "Reproduction" using collaborative learning strategies. A quasi-experimental design was employed in the study, conducted in four secondary schools in Rivers State. The population comprised 2,400 students, from which a sample size of 240 Senior Secondary II students was purposively selected. In each sampled school, one class was randomly assigned as the experimental group, where collaborative learning strategies were employed, while the other class served as the control group, taught using traditional lecture methods. Data were collected through pre-test and post-test assessments and analyzed using mean, standard deviation, and z-tests. Hypotheses were tested at a significance level of $p < 0.05$. The findings revealed that students taught using the collaborative learning strategy significantly outperformed those in the control group. The collaborative strategy proved effective in improving students' understanding and retention of the topic "Reproduction" in biology. Gender did not significantly influence the performance of students in the experimental group, indicating that collaborative strategies are effective across genders. Based on these findings, the study recommended the adoption of

collaborative learning strategies in teaching "Reproduction" and other related topics in biology. This method can enhance academic performance and foster interaction learning environments, benefiting students regardless of gender. The study highlights the potential of innovative teaching strategies to improve outcomes in science education at the secondary school level.

2.4 Conceptual Model

From the objective of this study, the following model is constructed:

Independent Variables **Dependent Variable**

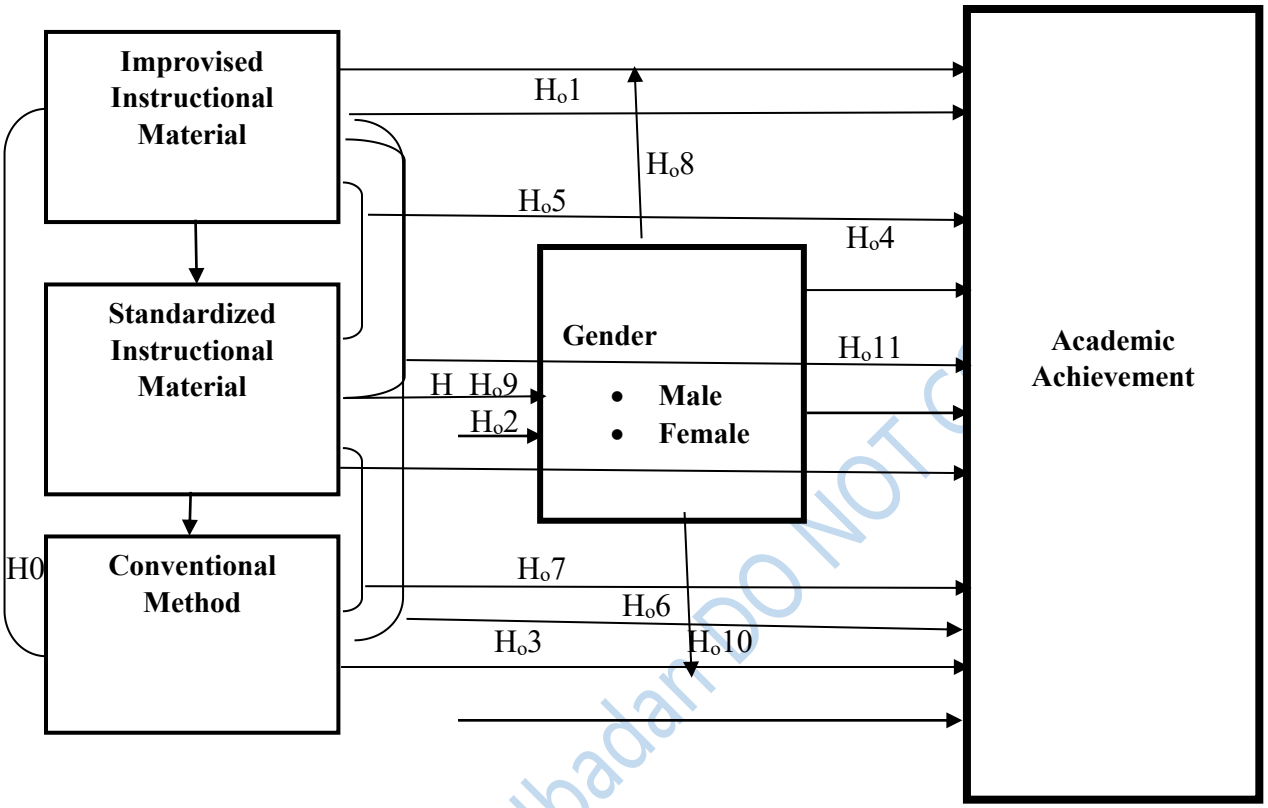

Figure 2.4 Conceptual Model on Effects of Improvised and Standardised Instructional Materials on Senior Secondary School Achievement in Biology in Oyo Metropolis, Oyo State.

2.5 Summary of Literature Reviewed

In conducting the literature review for this study, a comprehensive examination of the conceptual, theoretical, and empirical aspects related to the effects of improvised and standardised instructional materials on senior secondary school students' achievement in

biology in Oyo town, Oyo State was undertaken. Firstly, the conceptual review provided a foundational understanding of the subject matter by delving into the broader concepts of instructional materials, their significance in educational settings, and the potential impact they can have on students' academic performance. This segment elucidated the importance of instructional materials as essential tools for facilitating teaching and learning processes, highlighting their role in enhancing comprehension, engagement, and retention among students. Subsequently, the theoretical review delved into existing theoretical frameworks that shed light on the relationship between instructional materials and students' achievement. One prominent framework explored in this context was the Technology Acceptance Model (TAM), which posits that individuals' perceptions of usefulness and ease of use are critical determinants of their acceptance and adoption of new technologies, including instructional materials. This theoretical lens provided valuable insights into the psychological factors influencing students' attitudes towards instructional materials, thereby informing the conceptual framework of the study. Furthermore, the empirical review encompassed a synthesis of relevant studies and research findings pertaining to the effects of instructional materials on students' achievement in Biology. By examining empirical evidence from previous studies, the literature review sought to identify patterns, trends, and gaps in existing research, thereby informing the design and methodology of the present study. Key findings from prior research studies provided valuable context and groundwork for the formulation of hypotheses and research questions, guiding the direction of the current study.

Overall, the literature review served as a crucial precursor to the present study, laying the groundwork for a deeper understanding of the research topic and informing the design and methodology of the investigation. By synthesizing conceptual, theoretical, and empirical

insights, the literature review provided a robust foundation for the subsequent analysis and interpretation of data, contributing to the advancement of knowledge in the field of educational research.

Endnotes

1. A. Yusuf & T. Adewale, *Role of Socio-Emotional Competencies in Predicting Academic Success Among Secondary School Students in Kano*, **Nigerian Journal of Educational Psychology**, 21(4), 2023, 210-225.

2. T. Chamidy, M. A. Yaqin & M. H. Suhartono, *The Influence of Internal and External Factors on Learning Achievement*, Annual International Conference on Language, Literature and Media (AICoLLiM), 53 (4), 2023, 562-573.

3. U. Okafor & B. Adekunle, *Impact of parental involvement on the academic performance of secondary school students in Abuja,* **Nigerian Journal of Educational Research**, 20(3), 2023, 112-128.

4. L. Hensley, A. Kulesza, J. Peri, A. C. Brady, C. A. Wolters, D. Sovic & C. Breitenberger, *Supporting Undergraduate Biology Students' Academic Success: Comparing Two Workshop Interventions,* CBE life sciences education, 20(4), 2021, 60.

5. N. Eze & J. Musa, *Personalized Learning Approaches in Maximizing Learning Outcomes in Biology,* **Nigerian Journal of Educational Studies**, 19(3), 2022, 178-192.

6. T. Britannica, *Larynx*, Encyclopedia Britannica**.** Available online: https://www.britannica.com/science/larynx. 2023.

7. M. D. Abdulrahaman, N. Faruk, A. A. Oloyede, N.T. Surajudeen-Bakinde, L. A. Olawoyin, O.V. Mejabi, Y. O. Imam-Fulani, A. O. Fahm & A. L. Azeez, *Multimedia tools in the teaching and learning processes: A systematic review.* ***Heliyon*****,** *6*(11), e05312. Available online: https://doi.org/10.1016/j.heliyon.2020.e05312. 2020.

8. M. O. Adesola, G. B. Olorode & T. R. Ranmolate, *Effect of Instructional Materials on Biology Instructions among High Achieving Secondary School Students in SPED International Secondary School, Oyo, Nigeri*a, **Journal of Educational Research in Developing Areas**; 3 (2), 2022, 237-245.

9. C. Nwosu & E. Okonkwo, *Effectiveness of Instructional Materials in Facilitating Formative Assessment Practices in Nigerian Educational Settings*, **Nigerian Journal of Educational Psychology**, 19(1), 2021, 75-88.

10. N. Bright, *Effect of Improvised Instructional Materials on Senior Secondary School Students Achievement and Retention in Mathematics*, The International Technology Management Review. 4, 2020, 1-9.

11. D. Lukman, *How Improvisation of Instructional Materials Can Influence Students Academic Achievement.* Available online**:** https://imperialwriters7.medium.com/how-improvisation-of-instructional-materials-can-influence-students-academic-achievement-ae958138ae2b 2021**.**

12. I. Gabriel, A. Geoffrey & T. Wisdom, *Effect of Teacher-Learner Improvised Material on Creative Thinking Among Varied-Ability Upper Basic Science Students in Makurdi Metropolis*, **Journal of Science Technology**, 2(1), 2022, 72 - 80.

13. D. Mushimiyimana, E. Kampire & E. Dushimimana, *Impacts of Improvised Instructional Materials on Grade Nine Learners' Performance in Chemistry*, **African Journal of Educational Studies in Mathematics and Sciences,** 18(1), 2022, 127 – 135.

14. C. Umuhoza & A. Uworwabayeho, *Teacher's Use of Instructional Materials in Teaching and Learning Mathematics in Rwandan Primary Schools*, **African Journal of Teacher Education**, 10 (2), 2021, 1-16.

15. A. S. Munna & M. A. Kalam, *Teaching and Learning Process to Enhance Teaching Effectiveness: a Literature Review*, **International Journal of Humanities and Innovation (IJHI),** 4 (1), 2021, 1-4.

16. O. A. Okori & O. Jerry, *Improvisation and Utilization of Resources in the Teaching and Learning of Science and Mathematics in Secondary Schools in Cross River State*, **Global Journal of Educational Research**, 16, 2017 21-28.

17. M. Daniel, R. Alphonse & E. Twizeyimana, *Conceptual Understanding of Improvised Instructional Materials through Teachers' Perception of their Availability and Implication in Science Teaching and Learning Endeavors in the Southern Province of Rwanda,* **Journal of Global Research in Education and Social Science,** 14(2), 2020, 67-77.

18. J. S. Shaibu, K. Shuaibu, A. F. Obaje & I. Atawodi, *Improvisation of Instructional Materials: A Veritable Option in the Teaching and Learning of Social Studies in Secondary Schools, Kogi State, Nigeria*, **IOSR Journal Of Humanities And Social Science (IOSR-JHSS**), 28 (5); 2023, 15-21.

19. E. Bernadette, I. Franklin & C. Obikezie*, Comparative Effects of Teaching with Improvised Instructional Materials and Standard Instructional Materials on Secondary School Students' Academic Achievement in Chemistry*, 1, 2021, 27-40.

20. O. Obiukwu, U. Kingsley, O. Johnson, L. Enoch, E. Odinakachi, O. Mbalisi & J. Leonard, *Accessibility of Instructional Materials for Effective Teaching: Outlook from High Schools in Eleme, River State, Nigeria*, **Cypriot Journal of Educational Sciences,** 18. 456-469. 2023.

21. N. Acosta, *Development and Validation of Grade 10 Science Learning Materials in Selected Secondary Schools in District iii, Division of Puerto Princesa City, Philippines,* **Journal of Educational Research in Developing Areas**, 1(3), 2020, 248-264.

22. A. Anthony, *Instructional Design Standards for Distance Learning*. Available online: https://members.aect.org/publications/designstandards/DL_Design_Standards.pdf. 2017

23. O. Abidoye, A. Abidoye & O. Malik, *The Effect of Biology Teaching Materials on the Academic Performance of Senior Secondary School Students in Ilorin West, Ilorin, Kwara*

State, **International Journal of Educational Innovation and Research**, 2(1), 2023, 142-150.

24. S. Shantanu, A. Faiyaz & S. R. Kumar, *Validation of Health Education Material for Youth: A Step to Ensure Implementation Fidelity in Community-Based Interventions,* In: Healthcare, 8(1), 2020, 1-12.

25. M. Ozcan, *Factors Affecting Students' According to the Teachers' Opinion Academic Achievement*, **Education Reform Journal,** 6 (1), 2021, 1-18.

26. J. Mukagihana, F. Nsanganwimana & C. M. Aurah, *Biology Instructional Resources Availability and Extent of their Utilization in Teaching Pre-Service Biology Teachers*, **African Journal of Educational Studies in Mathematics and Sciences**, 16 (2), 2020, 33-50.

27. C. Nwosu & E. Okonkwo, *Role of technology-Enhanced Teaching Methods in Promoting Deeper Understanding among Nigerian Students,* **Nigerian Journal of Curriculum Studies**, 19(1), 2021, 75-88.

28. B. Michael, L. Randy, K. Kevin, C. Hodges, S. Moore, L. Barbara, T. Torrey & B. Mark, *Understanding Pandemic Pedagogy: Differences Between Emergency Remote, Remote, and Online Teaching*, 10.13140/RG.2.2.31848.70401. 2020.

29. V. T. Hung, C. P. Thanh, T. L. Huy, K. G. Shashi, N. T. Hang & N. C. Trung, *Proposing The Learning Style-Based Blended Learning Model to Develop Competence of Students in Online Teaching*, Review of International Geographical Education, 11(10), 2021, 2215-2227.

30. A. R. Kurup & M. K. Underwood, *Gender Diversity in Peer Relations: Best Research Practices and Marshalling Peer Influence*, **Journal of Applied Developmental Psychology**, *76*, 101328. https://doi.org/10.1016/j.appdev.2021.

31. E. Evans, *Political Intersectionality and Disability Activism: Approaching and Understanding Difference and Unity*, The Sociological Review, 70(5), 2022, 986-1004.

32. S. Mcleod, *Constructivism Learning Theory & Philosophy of Education.* Available online: https://www.simplypsychology.org/constructivism.html. 2024.

33. B. Brau, *Constructivism. In R. Kimmons, & S. Caskurlu (Eds.), The Students' Guide to Learning Design and Research*, EdTech Books. https://edtechbooks.org/studentguide/constructivism. 2020.

34. A. Saleem, H. Kausar & F. Deeba, *Social Constructivism: A New Paradigm in Teaching and Learning Environment*, **Perennial Journal of History**, 2, 2021, 403-421.

35. I. O. Akinwumi, *Effect of Inquiry Method on the Academic Achievement of Senior Secondary School Students in Biology in Ondo State, Nigeria*, **Himalayan Journal of Education and Literature,** 3 (5), 2022, 185-190.

36. F. Ebele & Z. Abubakar, *Effects of Group Investigation Strategy on Secondary School Students' Academic Achievement in Biology in Kwali Educational Zone of FCT-Abuja,* **International Journal of Innovative Research & Development**, 8 (12), 2019, 113 – 119.

37. D. G. Abalas, K. L. Andrew & M. S. Abifarin, *Effects of Simulation Strategy Senior Secondary Two Biology Students' Interest and Academic Achievement in Plateau Northern Senatorial Zone, Nigeria*, **International Journal of Research and Innovation in Social Science (IJRISS)**, 6(12), 2022, 60-64.

38. T. E. Agboghoroma & E. O. Oyovwi. *Evaluating Effect of Students' Academic Achievement on Identified Difficult Concepts in Senior Secondary School Biology in Delta State.* **Journal of Education and Practice**, 6, (30), 2015, 117 – 125.

39. O. Oyovwi. *Enhancing Biology Students' Academic Achievement and Attitude Through Self-Regulated Learning Strategy in Senior Secondary Schools in Delta Central Senatorial District*, **Journal of Educational and Social Research**, 9, (1), 2019, 149-156.

40. M. Y. Olawale, *Effect Of Improvised Instructional Materials On Biology Practical Skills Acquisition In Senior Secondary Schools In Lagos State*, **Port Harcourt Journal of Educational Studies,** 5(3), 2020, 136-200.

41. F. O. Abidoye & A. O. Abidoye, *Analysis of Effect of Science Instructional Materials on Students' Academic Performance in Ilorin-West, Kwara State*, **Edu Basic Journal: Journal Pendidikan Dasar**, 5(1), 2023, 1-10.

42. U. U. Usendu, J. O. Babayemi, P. J. Uko & E. U. Umoetuk, *Effect of Improvised Neuron Model and School Location on Senior Secondary School Students' Academic Achievement in Biology*, **International Journal of Developmental Research in Education (IJDRE),** 3 (1), 2023, 130-142.SS

43. B. I. Nwoke & O. M. Nwaneri, *Effect of Improvised Instructional Materials on Senior Secondary School Students Achievement and Retention in Mathematics*, The International Technology Management Review, 4 (1), 2020, 1-9.

44. C. Nja & J. Obi, *Effect of Improvised Instructional Materials on Academic Achievement of SS1 Chemistry Students in Cross River State Nigeria*, **International Journal of Applied Research**, 5(7), 2019, 444-448.

45. C. Nwosu, & E. Okonkwo, *Differential Effects of Instructional Materials on Students' Academic Performance and Interest in Geography: Evidence from Nigerian Secondary Schools,* **Nigerian Journal of Curriculum Studies**, 19(1), 2021, 75-88.

46. N. G. Ezechi, *Effect of Improvised Instructional Materials on Senior Secondary School Students' Achievement in Biology in Enugu South Local Government Area of Enugu State*, Nigeria, **International Journal of Engineering, Science and Mathematics**, 8 (3), 2019, 53 – 61.

47. M. Harrison, *Effect of the Use of Instructional Materials on Students' Academic Achievement in the Concept of Respiratory System*, Available online: https://researchkings.com.ng/2023/12/08/effect-of-the-use-of-instructional-materials-on-students-academic-achievement-in-the-concept-of-respiratory-system/ 2023.

48. V. U. Moses, *Influence of Instructional Materials on Students' Academic Performance in Biology in Calabar South Local Government Area, Cross River State*. Available online: https://ssrn.com/abstract=3531233, 2020, 1-50.

49. A. Isma'il & O. Lukman, *Availability and Utilization of Instructional Materials in Teaching and Learning of Biology in Senior Secondary Schools*, **Academia**, 6 (2), 2022, 1-8.

50. D. C. Anyakaorah, *Improvisation of Instructional Materials for Effective Teaching and Learning of Computer in Junior Secondary Schools In Ebonyi State*, **Unizik Journal of Educational Research and Policy Studies**, 8 (5), 2021, 20-29.

51. R. N. Muhoza, D. Imaniriho, A. Nshimiyimana, E. Nkunzabo, N. J. Ntezimana & P. N. Batera, *The Effect of Teaching Aids on Students' Performance in Biology Subject in O'level Secondary Schools in Kayonza District*, **Journal of Research Innovation and Implications in Education**, 7(2), 2023, 124 – 133.

52. S. O. Makinde & A. B. Abdulsalam, *Perceived Influence of Learning Resources Availability and Utilization on Senior Secondary School Student's Performance in Biology in Ilorin Metropolis*, **Nigerian Online Journal of Educational Sciences and Technology (NOJEST),** 4 (2), 2022, 71-79.

53. O. Eric, *Effects of Improvised Instructional Materials on Senior Secondary School Students' Academic Achievement and Interest in Mathematics in Enugu East Local Government Area Enugu State, Nigeria*, **Journal of Research in Science and Vocational Education (JRSVE),** 3(1), 2023, 115-123.

54. A. M. Owolabi, G. B. Olorode & T. R. Aranmolate, *Effect of Instructional Materials on Biology Instructions Among High Achieving Secondary School Students in SPED International Secondary School, Oyo, Nigeria*, **Journal of Educational Research in Developing Areas**, 3(2), 2022, 237-245.

55. C. E. Eseine- Aloja, *Effects of Gender on the Academic Performance of Public-School Biology Students Participating in School Organised Extra-Mural Classes*, **Sapientia Foundation Journal of Education, Sciences and Gender Studies (SFJESGS**), 3, (1), 2021, 337 – 349.

56. D. Ekineh & T. Adolphus, *Influence of Gender on Students' Performance in Biology when Taught Reproduction Using Collaborative Strategy in Secondary Schools in Rivers State*, 2019, 62-73.

Chapter Three
Methodology

This chapter presents the method used in the research done for this project. research design; population of the study; sample and sampling techniques; research instrument; validation of instrument; reliability of research instrument; method of data collection; method of analysis; and ethical approval.

3.1 Research Design

The research employed 3x2 factorial matrix quasi-experimental design of pre-test- post-test non-randomised and non-equivalent experimental control groups. It focused treatment at three levels (improvised instructional materials, standardised instructional materials and control group), moderate variable of gender and the dependent variable (academic achievement). Improvised and standardised instructional materials served as treatment for the experimental groups, while the conventional teaching method was served as a control group. Gender acted as a moderate variable in this study, and students' achievement in Biological Concept Achievement Test (BCAT) at both pre-test and post-test stages served as dependent variable.

Table 3.1 Schematic Representation

Group	Pretest	Gender	Treatment	Post Test
Experiment 1	O1	M1 F1	X1	O2
Experiment 2	O3	M2 F2	X2	O2
Control group O6	O5	M3 F3	X3	

Source: Field work 2024

Where

O_1= Pretest scores Intervention group 1

O_3=pretest scores of Intervention group 2

O_5= Pretest scores of control group

O_2=Posttest scores of Intervention group 1

O_4= Posttest scores of Intervention group 2

O_6= Posttest scores of control group

X_1= Experimental group 1 (Improvised instructional material)

X_2= Experimental group 2 (Standardised instructional material)

X_3= Conventional (Control group)

3.2 Population of the study

The population for this study comprised 13,716 senior secondary school II students in the Oyo town which comprised of Afijio, Atiba, Oyo East, and Oyo West Local Government Areas of Oyo State, Nigeria, as at the time of the survey.

Selected Educational Zone	Name of Local Government	Nos. of SSS 2 Students
Oyo Educational Zone	Afijio	2556
	Atiba	3756
	Oyo East	3992
	Oyo West	3412

Source: Oyo Educational Zone of Teaching Service Commission, TESCOM, Oyo State, GRA, Oyo.

3.3 Sample and Sampling Techniques

The researcher used purposive sampling techniques to select a total of 149 of three intact classes of Senior Secondary School II (SS II) biology students at the following schools: Anglican Methodist Secondary School, Oyo; Ojongbodu Grammar School, Oyo; and Community Commercial Secondary School, Oke Olola. The selection criteria included the following:

1. The schools that are government owned must be public
2. Each school has at least one qualified biology teacher for SS II.
3. Schools that have Biology teachers with at least of seven years of experience as examiners for external examination bodies.
4. The schools that have graduated students in WAEC for more than 15 years.
5. Schools that have standard biology laboratories.

The study focused on three local governments 'areas that were randomly selected within the Oyo Educational Zone of Oyo State. A public co-educational secondary school was purposively selected from each local government areas. In Atiba Local Government Area, Community Commercial Secondary School, Oke Olola, was chosen, comprising 60 SS II Biology students. In Oyo East Local Government Area, Anglican Methodist Secondary School, Ajagba, with 47 SS II biology students. Finally, Ojogbodu Grammar School in Oyo West Local Government Area was selected, with 42 SS II biology students. The participants were chosen because the SS II biology curriculum includes respiratory system. Schools were randomly assigned to the treatment

Sample Distribution

Selected Educational Zone	Nos. of Local Government	No. of Local Government Selected	No. of Public Secondary Schools	No of Schools Selected
Oyo Educational Zone	04	03	56	03

Source: Oyo Educational Zone of Teaching Service Commission, TESCOM, Oyo State, GRA, Oyo.

3.4 Research Instruments

The instruments used for this study were (1) Biology Achievement Test (BAT) for both the pre-test and post-test assessments. (2) Lesson note format for improvised instructional materials (3) Lesson notes format for standardised instructional material and (4) Lesson note format for conventional (control).

3.4.1. Description of Research Instruments

3.4.1.1. Biology Achievement Test (BAT) 1-Pre-Test

Data collection for the biology Achievement Test (BAT) involved administering the test to the students, which consisted of two sections. Section A gathered demographic information about the students, while Section B included 20 multiple-choice questions designed to assess their biological knowledge. These questions were structured in a self-developed format, with answer choices labeled A through E. Scoring was done manually, awarding one (1) point for each correct response and zero (0) points for incorrect answers, resulting in a total possible score of 20 marks.

Table 3.2. Table of Specification for Biology Achievement Test (BAT1) (Pretest)

Topic/Level of Cognition	Remember	Understand	Apply	Analysis	Evaluation	Create	Total
Concept of Respiration	1			1	1		3
Condition necessary for Respiration		2					1
Types of Respiration	1		3			1	4
Mechanism of Respiration in Mammals	2	1	3	3	1		12
TOTAL	4	3	6	4	2	1	20

3.4.1.2. Biology Achievement Test (BAT2- Post-test)

BAT2 was a revised version of BAT1. At the conclusion of the experiment, the pre-test items were administered to all three groups.

3.4.1.3. Lesson Note Format for Improvised Instructional Materials

The research assistants provided instruction using makeshift tools, including lung models and other locally produced materials, to enhance the learning experience. Utilizing the lung model, they demonstrated how each respiratory organ functions during the breathing process and prepared lecture notes on the mechanics of the lungs. This biology lesson plan is central to the study, guiding students through the respiratory system process and directing instruction effectively.

Lung Model

The lung model serves as a makeshift tool for teaching lung function during breathing, particularly in the absence of traditional laboratory equipment. By using rubber balloons and plastic straws to represent the trachea and bronchi, the model illustrates how the diaphragm controls the breathing process. When the diaphragm moves downward, it allows fresh air to enter the lungs. Conversely, when the diaphragm contracts upward, it causes the lungs to expel used air, resulting in exhalation. This hands-on approach makes the concept of lung function more accessible and engaging for students.

3.4.1.4. Lesson Notes Format for Standardised Instructional Materials

The research assistants utilised a variety of established resources for their work. The treatment aimed at enhancing learning incorporated readily available pre-made materials from educational institutions. To demonstrate how each respiratory organ functions during breathing, the research assistants developed lesson notes on lung mechanics and presented a video that illustrated the mammalian respiratory system and its associated organs

Lesson Notes Structure for Control Group

The research assistants instructed without any teaching aids. The research assistant was more active while the students were passive; they depended on a chalkboard for teaching purposes. The research assistants created lesson notes on how lungs function using chalk and speech.

3.5 Validity of the Research Instruments

Two experts at Lead City University, Ibadan, Nigeria and the researcher's supervisor validated the study instrument. All corrections and modifications were effected before the final document was produced.

3.6 Reliability of Research Instrument

A pilot study was conducted to determine the reliability of the research instrument which is the Biological Achievement Test (BAT). The researcher gave the research instrument to a population sample not included in the main investigation. Reliability coefficient was calculated using Kuder Richardson-20 (KR-20 = 0.8).

3.7 Data Collection

A letter of recommendation was obtained from the Head of Department, Science Education, Lead City University, Ibadan and sent to the principals of the chosen schools before the instruments were given to the group of selected students. The consent and cooperation of three research assistants and the selected students were sought before the administration of the instrument to the students. Three teaching strategies (improvised, standardised teaching materials and conventional) were applied. The study spanned eight weeks. Biology teachers

in each school served as research assistants. For the first and second (1st and 2nd) weeks, they were instructed in the role they were supposed to fulfil in the research, the third (3rd) week was utilised to pre-test every group, while the fourth, fifth, sixth, and seventh (4th, 5th, 6th and 7th) weeks were used for treatment and eighth (8th) week for post-test. Following a set process, data was gathered: selection and training of research assistants; pre-test administration; treatment and post-test administration.

Timeline of Research Activities

Week One – Two:

- **Training of Research Assistants**: This period focused on training research assistants to ensure they are well-prepared to support the study. They learned about the research objectives, data collection methods, and ethical considerations.
- **Production of Lungs Model**: During this time, the research team worked on creating a model of the lungs to be used as an instructional tool in the study.

Week Three:

- **Administration of Pre-tests**: In this week, the pre-tests was administered to all participants to assess their initial understanding of the respiratory system. This provided a baseline measure for evaluating the effectiveness of the instructional interventions.

Week Four – Seven

Treatment Phase: This phase involved implementation of different teaching strategies (conventional, standardised, and improvised instructional materials) with the participating students. Instruction was conducted over these weeks, allowing time for the participants to engage with the materials and concepts thoroughly.

Week Eight:

- **Post-tests**: At the end of the treatment phase, posttests were administered to evaluate the academic achievement of the students in the respiratory system topics. This allowed a comparison of pretest-posttest scores which determined the effectiveness of the instructional methods used in the study.

3.8 Method of Data Analysis

The information gathered was examined using frequency counts and standard deviation while the hypotheses for the study were tested using ANCOVA at 0.05 level of significance.

3.9 Approval Ethically

For every Biology Achievement Test (BAT), the participants were asked to sign a consent form; and then confidentiality of every information was ensured during statistical examination and discussion of the outcomes.

Endnotes

1. Oyo Educational Zone of Teaching Service Commission, TESCOM, Oyo State, GRA, Oyo.

Chapter Four
Results and Discussion of Findings

The results and discussion of findings of the study are presented in this chapter. The findings were based on the hypotheses that were raised in accordance with the study's objectives.

4.1 Presentation of Data

Table 4.1 Demographic Data

Variable	Frequency	Percentage
Gender		
Male	65	43.6%
Female	84	56.4%
Total	**149**	**100.0%**

Source: Field Survey Report, 2024

Table 4.1 presents the distribution of participants based on gender. Out of the total participants, 65 (43.6%) identified as male, while 84 (56.4%) identified as female. This shows a relatively balanced representation of both genders in the study.

4.2 Presentation of Data

4.2 Descriptive Statistics of the Dependent Variable – Students Performance in Biology

	Pretest	Posttest
N	149	149
Missing	0	0
Mean	29.55	52.61
Median	32.00	55.00
Standard deviation	10.060	17.938
Minimum	10.00	22.00
Maximum	56.00	92.00

Source: Field Survey Report, 2024

Table 4.2 provides descriptive statistics for the dependent variable, students' academic performance in the Biology Achievement Test (BAT). For pretest, the sample size (N) is 149, indicating the number of learners that took part in the pretest. There are no missing values, meaning that all participants had scores for the pretest. The mean value of the pretest is 29.55, indicating that, on average, the pretest in the sample scored relatively below the average which is 50.00. The median value is 32.00, which suggests that the distribution of responses is slightly skewed towards lower performance. The standard deviation is 10.060, which implies that there is a moderate amount of variability in the pretest scores. Furthermore, the least and the maximum scores are 10 and 56, respectively. Similarly, for posttest, the sample size is also 149, and there are no missing values. The mean value for posttest is 52.60,

indicating a relatively high average score. The median value of 55.00 suggests that the distribution of responses is slightly skewed towards higher performance score. The standard deviation is 17.938, indicating a moderate amount of variability in the responses for the posttest score. While the least and the maximum scores are 22 and 92, respectively. This implies there is an improvement in the performance of students after the intervention (use of new teaching strategies) but the magnitude of the improvement was determined with the Analysis of Covariance (ANCOVA).

Table 4.3: Summary of Analysis of Covariance (ANCOVA) on the Post-test Achievement Scores in Biology According to Teaching Strategies and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Main effects					
Corrected Model	25163.999[a]	4	6291.000	42.658	.000
Intercept	387212.325	1	387212.325	2625.634*	.000
Standardised	7512.243	1	7512.243	50.939*	.000
Improvised	6876.235	1	6876.235	46.627*	.000
Conventional	213.506	1	213.506	1.448	.231
Gender	447.474	1	447.474	3.034	.084
Error	20203.917	144	147.474		
Total	438332.000	149			
Corrected Total	45367.915	148			

a. R Squared = .555 (Adjusted R Squared = .542)

Source: Field Survey Report, 2024 * denoted significant at $_p \leq 0.05$.

Findings from the study are presented below following the hypotheses tested.

$H_0$1: There will be no significant main effect of improvised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics.

Table 4.2 shows that there was a significant main effect of improvised instructional materials on the academic achievement of senior secondary school students in biology instructional

materials [$F_{(1;144)}$ = 46.627; P-value < 0 .05]. Hence the H_o is rejected. This implies that there is significant difference in the pretest and posttest scores of students taught with improvised instructional materials.

$H_0$2: There will be no significant main effect of standardised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics.

There was significant main effect of standardised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics. [$F_{(1;144)}$ = 50.939; P-value < 0.05]. Since P–value < 0.05, the H_o is therefore rejected. This implies when students taught with the use of standardised instructional materials outperformed their counterparts that were not exposed to the same teaching instruction.

$H_0$3: There will be no significant main effect of conventional method on academic achievement of Senior Secondary School biology students in respiratory system topics.

The result from Table 4.2 revealed that There will be no significant main effect of conventional method on academic achievement of Senior Secondary School biology students in respiratory system topics. [$F_{(1;144)}$ =1.448; P >0.05], the H_o is therefore not rejected. This implies that the conventional method was not effective in teaching biology, especially, respiratory system topics among SS2 Students.

$H_0$4: There will be no significant main effect of gender on academic achievement of Senior Secondary School biology students in respiratory system topics.

As depicted in the Table 4.2, there will be no significant main effect of gender on academic achievement of Senior Secondary School biology students in respiratory system topics.

[$F_{(1;144)}$ =3.034; P- value >0.05], the H_o is therefore not rejected. This implies that gender has no significant effect on the SS2 students' academic performance in Biology.

Table 4.4: Summary of 2-Ways Analysis of Covariance (ANCOVA) on the Post-test Achievement Scores in Biology According to Teaching Strategies and Gender.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
2-Ways interactions					
Corrected Model	26818.109[a]	10	2681.811	18.939	.000
Intercept	323513.278	1	323513.278	2284.673	.000
Standardised * Improvised	1393.954	1	1393.954	19.844*	.000
Improvised * Conventional	1215.928	1	1215.928	15.042*	.001
Standardised * Conventional	1323.980	1	1323.980	17.028*	.000
Improvised * Gender	63.638	1	63.638	.449	.504
Standardised * Gender	77.434	1	77.434	.547	.461
Conventional * Gender	175.639	1	175.639	1.240	.267
Error	18549.807	138	141.602		
Total	438332.000	149			
Corrected Total	45367.915	148			
a. R Squared =0 .591 (Adjusted R Squared =0 .560)					

Source: Field Survey Report, 2024 * denote significant at $_p \leq 0.05$.

$H_0$5: There will be no significant interaction effect of improvised and standardised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics.

Two ways ANCOVA results from Table 4.3 revealed that there is significant interaction effect of standardised and improvised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics: [$F_{(1; 138)}$ = 19.844; P - value<0 .05]. With this result, the H_o is rejected. This indicates that when standardised and improvised instructional materials are employed simultaneously, students perform better in respiratory system topics.

$H_0$6: There will be no significant interaction effect of conventional method and improvised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics.

From Table 4.3, it was observed that there was significant interaction effect of conventional method and improvised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics: [$F_{(1;138)}$ = 15.042; P-value <0.05], the H_o is therefore rejected. This implies that when conventional methods combined with improvised instructional materials, academic performance of students is enhanced.

$H_0$7 There will be no significant interaction effect of conventional method and standardised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics.

Result from table 4.3 above shows that there was significant interaction effect of conventional method and standardised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics: [$F_{(1;138)}$ =17.028; P-value<0.05], the H_o is therefore rejected. This implies that students' academic performance will be improved when conventional method and standardised instructional materials are used to teach biology, especially, respiratory system topics.

$H_0$8: There will be no significant interaction effect of conventional method and gender on academic achievement of Senior Secondary School biology students in respiratory system topics.

The result from Table 4.3 that there is no significant interaction effect of conventional method and gender on academic achievement of Senior Secondary School biology students

in respiratory system topics: [$F_{(1;138)}$ =1.240; P-value >0.05], the H_o is therefore not rejected. The implication of this result is that there is no significant difference in male and female students when conventional method is used to teach biology.

Table 4.4: Summary of 3-ways interactions Analysis of Covariance (ANCOVA) on the Post-test Achievement Scores in Biology According to Teaching Strategies and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
3-Ways interactions					
Corrected Model	27259.231[a]	14	1947.088	13.655	.000
Intercept	295206.132	1	295206.132	2070.342*	.000
Standardised * Improvised * Conventional	230.801	1	230.801	11.619*	.000
Improvised * Conventional * Gender	56.753	1	56.753	.398	.529
Standardised * Conventional * Gender	37.540	1	37.540	.263	.609
Standardised * Improvised * Gender	88.365	1	88.365	.620	.433
Error	18108.685	134	142.588		
Total	438332.000	149			
Corrected Total	45367.915	148			

a. R Squared = .601 (Adjusted R Squared = .557)

Source: Field Survey Report, 2024 * denote significant at $p \leq 0.05$.

$H_0$9: There will be no significant interaction effect of conventional method, improvised instructional materials and standardised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics.

From Table 4.4, the 3-ways ANOVA results shows that there was significant interaction effect of conventional method, improvised instructional materials and standardised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics: [$F_{(1;134)}$ =11.619; P-value <0.05], the H_o is therefore

rejected. This implies that conventional method, improvised instructional materials and standardised instructional materials will enhance students' academic achievement in Biology.

$H_0$10: There will be no significant interaction effect of improvised instructional materials, standardised instructional materials and gender on academic achievement of Senior Secondary School biology students in respiratory system topics.

Table 4.4 shows that there was no significant interaction effect of improvised instructional materials, standardised instructional materials and gender on academic achievement of Senior Secondary School biology students in respiratory system topics: [$F_{(1;134)}$ =0.620; $_P$ – value >0.05], hence, the H_o is not rejected.

$H_0$11: There will be no significant interaction effect of conventional method, improvised instructional materials and standardised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics.

From Table 4.4, the 3-ways ANOVA results shows that there was significant interaction effect of conventional method, improvised instructional materials and standardised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics: [$F_{(1,\ 134)}$ =11.619; $_P$-value <0.05], the H_o is therefore rejected. This implies that conventional method, improvised instructional materials and standardised instructional materials will enhance students' academic achievement in biology.

4.3 Discussion of Findings

The findings of this study are discussed based on the objectives of the study as guided by research hypotheses. Eleven hypotheses were raised and tested to guide the study. The first four hypotheses were tested to test for the main effects of improvised instructional materials,

standardised instructional materials, conventional and gender on students' academic achievement in biology.

The first objective of this study is to examine the main effect of standardised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics;

The analysis of covariance (ANCOVA) results indicates a statistically significant main effect of standardised instructional materials on the academic achievement of Senior Secondary School biology students regarding respiratory system topics. This finding suggests that standardised instructional materials play a critical role in enhancing students' learning outcomes by providing a structured, consistent, and well-organised format for delivering content. This result is in agreement with past studies which posit that standardised instructional materials facilitate better understanding and retention of the subject matter due to their alignment with established curricular standards, promoting uniformity in instructional quality[1,2]. Additionally, the significant effect highlights the potential of standardised instructional approaches to bridge knowledge gaps among students, thus contributing to a more equitable distribution of educational attainment across different student populations in the region.

The second objective of the study is to examine the main effect of improvised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics. The ANCOVA results reveal a statistically significant main effect of improvised instructional materials on the academic achievement of Senior Secondary School biology students in respiratory system topics. This suggests that improvised materials, which are often context-specific and creatively adapted to suit local realities, may provide a

more engaging and relatable learning experience that enhances students' comprehension and retention of biological concepts. The significant effect implies that the flexibility and adaptability of improvised instructional resources can compensate for limitations in standardised materials, offering an alternative pathway to improving learning outcomes in resource-constrained educational settings. This finding aligns with previous studies which underscore the value of integrating locally available resources into the instructional process to support diverse learning needs and foster deeper understanding of scientific content[3,4,5].

The third objective is to examine the main effect of conventional method on academic achievement of Senior Secondary School biology students in respiratory system topics. The findings reveal that there is no significant main effect of conventional instructional materials on the academic achievement of Senior Secondary School biology students in relation to respiratory system topics. This suggests that the use of conventional materials, such as textbooks and standard visual aids, may not be sufficient on their own to enhance student understanding or performance in this subject area. Several factors may contribute to this lack of significance. First, conventional instructional materials may not fully engage students or address diverse learning styles, which can hinder comprehension and retention. In a rapidly evolving educational landscape, students often benefit from more interaction, context-specific, and innovative teaching approaches that go beyond traditional methods.

Additionally, the effectiveness of conventional materials may be influenced by the quality and relevance of the content presented. If the materials are outdated or do not adequately reflect current scientific understanding, their impact on student achievement could be limited. Furthermore, the implementation of these materials by educators plays a crucial role; varying teaching styles, classroom management, and instructional strategies can significantly affect

how students interact with and learn from conventional resources. This finding is agreement with those studies which highlights the need for educators to evaluate and potentially supplement conventional instructional materials with more dynamic and engaging teaching methods, such as hands-on experiments, group discussions, or the integration of technology[6,7]. By doing so, educators can create a more holistic learning environment that addresses the diverse needs of students, ultimately fostering better academic outcomes in biology. Overall, the absence of a significant main effect suggests a reevaluation of instructional strategies is warranted to enhance student learning in this critical subject area.

The fourth objective is to determine the main effect of gender on academic achievement of Senior Secondary School biology students in respiratory system topics. Similarly, The ANCOVA results indicate that there is no statistically significant main effect of students' gender on the academic achievement of Senior Secondary School biology students in respiratory system topics. This finding suggests that gender does not play a determining role in students' performance in biology, implying that both male and female students benefit equally from the instructional methods used. The absence of a significant gender effect may reflect the effectiveness of the instructional strategies in providing an equitable learning environment, thus narrowing potential gender-related disparities in science education. These results support the notion by past researchers that when given equal learning opportunities and resources, students' academic outcomes in biology can be independent of gender[8,9,10].

The next four objectives of this study are to investigate the interaction effect of conventional method, improvised instructional materials, conventional methods and gender. To achieve these, four hypotheses were formulated and tested. This is the discussion of findings as shown in Table 4.4.

The fifth objective of this study is to verify the interaction effect of standardised and improvised instructional materials on academic achievement of Senior Secondary School biology students in respiratory system topics. The two-way ANCOVA results reveal a significant interaction effect between standardised and improvised instructional materials on the academic achievement of Senior Secondary School biology students in respiratory system topics. This finding showed that the combined use of standardised and improvised materials may produce a synergistic effect, enhancing students' learning outcomes more effectively than either approach alone. The interaction indicates that integrating the structured format of standardised materials with the contextual adaptability of improvised resources can enrich the instructional experience, catering to diverse learning preferences and facilitating a deeper understanding of complex biological concepts. These results underscore the pedagogical value of employing a blended instructional strategy that leverages the strengths of both standardised and improvised materials to maximise educational impact. The results have implications for educators, suggesting that combining standardised and improvised materials can create a robust learning environment that supports student success in biology.

The sixth objective is to verify the interaction effect of conventional method and improvised instructional materials on academic achievement of senior secondary school biology students in respiratory system topics.

The findings reveal a significant interaction effect between conventional instructional materials and improvised instructional materials on the academic achievement of senior secondary school biology students regarding respiratory system topics. This interaction suggests that the combined use of these two types of instructional materials enhances students' learning outcomes more effectively than when either is used alone. The synergistic

impact of conventional and improvised materials can be attributed to their complementary roles in the learning process. Conventional instructional materials, such as textbooks and established visual aids, provide a structured and familiar framework for students. They deliver essential content aligned with the curriculum, ensuring that foundational knowledge is clearly presented. In contrast, improvised instructional materials, which are often context-specific and tailored to students' immediate environment, can make learning more relatable and engaging. These materials often facilitate hands-on experiences, allowing students to apply theoretical concepts in practical scenarios, thus enhancing their understanding.

The interaction between these two types of materials highlights the importance of a multimodal approach to instruction. When students are exposed to both conventional and improvised materials, they benefit from the stability and reliability of conventional resources while simultaneously engaging with the dynamic and relevant nature

The seventh objective of this study is to examine the interaction effect of conventional method and standardised instructional materials on academic achievement of senior secondary school biology students in respiratory system topics.

The findings indicate a significant interaction effect between conventional instructional materials and standardised instructional materials on the academic achievement of senior secondary school biology students concerning respiratory system topics. This interaction suggests that the combined use of both conventional and standardised materials enhances students' learning outcomes more effectively than either approach used in isolation.

The synergistic effect observed may arise from the complementary strengths of both types of materials. Conventional instructional materials, such as textbooks and worksheets, provide

structured content and traditional pedagogical approaches that are familiar to students. In contrast, standardised instructional materials often offer a more uniform and systematic presentation of information aligned with curricular objectives. When used together, these materials can cater to diverse learning preferences and reinforce students' understanding through multiple representations of the same content.

Moreover, this interaction effect underscores the importance of integrating various instructional approaches to create a richer learning environment. The combination of conventional and standardised materials may facilitate deeper engagement, as students can benefit from the consistency of standardised resources while still enjoying the familiarity and accessibility of conventional tools. This dual approach may promote active learning and critical thinking by providing students with opportunities to explore the respiratory system from multiple perspectives.

Educators should consider leveraging this interaction effect by strategically incorporating both types of materials in their teaching practices. Doing so can enhance student engagement and academic achievement, particularly in complex topics such as the respiratory system. Additionally, this finding advocates for ongoing curriculum development that embraces a multimodal approach to instruction, ensuring that students receive a well-rounded educational experience that maximises their potential for success in biology. Overall, the significant interaction effect highlights the value of utilizing a diverse array of instructional materials to meet the varied needs of students and foster a deeper understanding of biological concepts.

The eighth objective of this study is to examine the interaction effect of improvised instructional materials and gender on the academic achievement of Senior Secondary School biology students in respiratory system topics.

The two-way ANCOVA results demonstrate that there is no significant interaction effect between improvised instructional materials and gender on the academic achievement of Senior Secondary School biology students in respiratory system topics. This finding suggests that the impact of improvised instructional materials on students' academic performance is not influenced by gender, indicating that both male and female students benefit similarly from these resources. The lack of a significant interaction effect highlights the capacity of improvised materials to support equitable learning outcomes, reinforcing their suitability for diverse student groups regardless of gender. These results imply that gender-neutral instructional strategies involving improvised resources can effectively cater to the learning needs of all students.

Similarly, the ninth objective is to examine the interaction effect of standardised instructional materials and gender on the academic achievement of Senior Secondary School biology students in respiratory system topics.

The two-way ANCOVA results indicate no significant interaction effect between standardised instructional materials and gender on the academic achievement of Senior Secondary School biology students in respiratory system topics. This suggests that the effectiveness of standardised instructional materials in enhancing academic performance is consistent across both male and female students, implying that gender does not moderate the impact of these materials. The absence of a significant interaction effect underscores the potential of standardised instructional approaches to provide equitable educational benefits regardless of

gender, promoting uniformity in learning outcomes. These findings align with past studies which highlight the robustness of standardised materials in delivering content that meets the learning needs of all students equally, irrespective of gender differences[11,12].

The tenth objective is to examine the interaction effect of improvised instructional materials, standardised instructional materials and gender on academic achievement of Senior Secondary School biology students in respiratory system topics.

The three-way ANCOVA results indicate no significant interaction effect among standardised instructional materials, improvised materials, and gender on the academic achievement of Senior secondary school biology students in respiratory system topics. This outcome suggests that the combined influence of these instructional approaches and gender does not differentially affect students' academic performance, implying that the benefits of using both standardised and improvised materials are consistent across male and female students. The absence of a significant interaction underscores the potential of integrating diverse instructional resources to support equitable learning experiences, regardless of gender, thus affirming the effectiveness of these strategies in providing balanced educational opportunities. These findings highlight that gender does not moderate the impact of instructional methods on academic outcomes when both standardised and improvised resources are employed.

The eleventh objective is to determine the interaction effect of improvised instructional materials, standardised instructional materials and conventional method on academic achievement of Senior Secondary School Biology students.

The findings reveal a significant interaction effect of conventional instructional materials, standardised instructional materials, and improvised instructional materials on the academic

achievement of Senior Secondary School biology students concerning respiratory system topics. This interaction indicates that the simultaneous use of these three types of instructional materials yields greater educational outcomes than any of the materials used independently. The effective interplay between these materials can be attributed to their complementary strengths. Conventional instructional materials, such as textbooks and traditional teaching aids, provide a structured and organised presentation of content, ensuring that foundational knowledge is clearly communicated. Standardised instructional materials contribute a consistent framework that aligns with curriculum objectives, reinforcing essential concepts and helping students understand the content in a systematic manner. On the other hand, improvised instructional materials offer context-specific and often hands-on learning experiences that make complex biological concepts more relatable and engaging for students.

The significant interaction suggests that when educators combine these approaches, they create a richer and more dynamic learning environment. The conventional materials lay the groundwork for understanding, while standardised materials reinforce and standardise that knowledge. Meanwhile, improvised materials can facilitate experiential learning, allowing students to apply theoretical concepts in real-world contexts. This holistic approach caters to various learning styles and promotes deeper cognitive engagement, ultimately leading to improved academic achievement.

Moreover, this finding highlights the importance of a multimodal instructional strategy in science education. It emphasises that educators should not rely solely on one type of instructional material but instead incorporate a variety of resources to address the diverse needs of students. By blending conventional, standardised, and improvised materials,

teachers can create a more effective and inclusive learning environment. Overall, the significant interaction effect of these materials advocates for an integrative approach to teaching biology, particularly in complex topics like the respiratory system. This finding encourages educators to explore innovative combinations of instructional materials, fostering enhanced student engagement and improved academic outcomes. Such practices can better prepare students to grasp intricate scientific concepts and succeed in their studies.

Endnotes

1. C. Umuhoza & A. Uworwabayeho, *Teacher's Use of Instructional Materials in Teaching and Learning Mathematics in Rwandan Primary Schools*, **African Journal of Teacher Education**, 10 (2), 2021, 1-16.

2. O. A. Okori & O. Jerry, *Improvisation and Utilization of Resources in the Teaching and Learning of Science and Mathematics in Secondary Schools in Cross River State*, **Global Journal of Educational Research**, 16, 2017 21-28.

3. M. Daniel, R. Alphonse & E. Twizeyimana, *Conceptual Understanding of Improvised Instructional Materials through Teachers' Perception of their Availability and Implication in Science Teaching and Learning Endeavors in the Southern Province of Rwanda,* **Journal of Global Research in Education and Social Science,** 14(2), 2020, 67-77.

4. O. Obiukwu, U. Kingsley, O. Johnson, L. Enoch, E. Odinakachi, O. Mbalisi & J. Leonard, *Accessibility of Instructional Materials for Effective Teaching: Outlook from High Schools in Eleme, River State, Nigeria*, **Cypriot Journal of Educational Sciences,** 18. 456-469. 2023.

5. O. Abidoye, A. Abidoye & O. Malik, *The Effect of Biology Teaching Materials on the sAcademic Performance of Senior Secondary School Students in Ilorin West, Ilorin, Kwara State*, **International Journal of Educational Innovation and Research**, 2(1), 2023, 142-150.

6. M. Ozcan, *Factors Affecting Students' According to the Teachers' Opinion Academic Achievement*, **Education Reform Journal,** 6 (1), 2021, 1-18.

7. I. O. Akinwumi, *Effect of Inquiry Method on the Academic Achievement of Senior Secondary School Students in Biology in Ondo State, Nigeria*, **Himalayan Journal of Education and Literature,** 3 (5), 2022, 185-190.

8. F. Ebele & Z. Abubakar, *Effects of Group Investigation Strategy on Secondary School Students' Academic Achievement in Biology in Kwali Educational Zone of FCT-Abuja,* **International Journal of Innovative Research & Development**, 8 (12), 2019, 113 – 119.

9. D. G. Abalas, K. L. Andrew & M. S. Abifarin, *Effects of Simulation Strategy Senior Secondary Two Biology Students' Interest and Academic Achievement in Plateau Northern Senatorial Zone, Nigeria*, **International Journal of Research and Innovation in Social Science (IJRISS)**, 6(12), 2022, 60-64.

10. M. Y. Olawale, *Effect Of Improvised Instructional Materials On Biology Practical Skills Acquisition In Senior Secondary Schools In Lagos State*, **Port Harcourt Journal of Educational Studies,** 5(3), 2020, 136-200.

11. F. O. Abidoye & A. O. Abidoye, *Analysis of effect of science instructional materials on students' academic performance in Ilorin-West, Kwara State*, **Edu Basic Journal: Journal Pendidikan Dasar**, 5(1), 2023, 1-10.

12. C. Nwosu, & E. Okonkwo, *Differential Effects of Instructional Materials on Students' Academic Performance and Interest in Geography: Evidence from Nigerian Secondary Schools,* **Nigerian Journal of Curriculum Studies**, 19(1), 2021, 75-88.

Chapter Five
Conclusion

5.1 Summary of Findings

With the use of descriptivse and inferential statistics, this study was able to draw its conclusion. A mean score of 29.55, which is below the average threshold, indicates that traditional teaching approaches were associated with lower student performance, according to descriptive statistics. An increase from a pre- to post-test mean score of 29.55 (a statistically significant difference) indicates that students' academic performance in biology improved somewhat when taught using both standardised and improvised teaching tools.

Table 4.3 displays the findings of the ANCOVA analysis, which show that improvised teaching materials have a significant main effect on the academic achievement of students in senior secondary school [$F_{(1;144)} = 46.627$; $P < 0.05$]. The [$F_{(1;144)} = 50.939$; $P < 0.05$] shown that standardised instructional materials had a notable impact on the academic achievement of Biology students in their last year of secondary school when it came to respiratory system-related subjects. Results showed that traditional methods did not significantly affect students' performance in respiratory system classes [$F_{(1;144)} = 1.448$; $P > 0.05$]. Students' performance on tests pertaining to the respiratory system was also unaffected by their gender in senior high school biology [$F_{(1;144)} = 3.034$; $P > 0.05$]. Table 4.4 shows that there is a significant interaction impact between standardised and improvised teaching materials on the academic achievement of students in respiratory system themes in senior secondary school biology ($F_{(1;138)} = 19.844$; $P <$ the significance level of 0.05). The results showed that traditional and makeshift teaching tools had a substantial interaction effect. Still, when it came to the respiratory system, there was no significant interaction effect between gender and traditional approaches in terms of the academic achievement of students in senior secondary school

biology [$F_{(1;138)} = 1.240$; $P > 0.05$]. According to Table 4.5, there was a significant impact on the academic performance of biology students in senior secondary school when using a combination of traditional, creative, and standardised teaching materials for themes related to the respiratory system ($F_{(1;134)} = 11.619$; $P < 0.05$). However, when looking at students' performance on themes related to the respiratory system, there was no significant interaction impact between gender, standardised vs. improvised instructional materials, or $F_{(1;134)} = 0.620$.

5.2 Conclusion

This research investigates the impact of different teaching strategies specifically conventional methods, standardised instructional materials, and improvised instructional materials on the academic achievement of Senior Secondary School biology students, particularly regarding the respiratory system.

The study demonstrates that a combination of standardised and improvised instructional materials leads to improved academic performance, suggesting that these strategies effectively enhance student learning. The research reveals significant interaction effects among teaching methods and gender, indicating that these variables influence students' academic outcomes. However, the study also finds no significant disparities in performance between male and female students when using conventional methods. The use of improvised instructional materials, combined with conventional methods, is shown to be beneficial for student understanding and performance, encouraging educators to adopt more innovative teaching practices. The findings inform educators about the importance of integrating various teaching strategies and provide a basis for developing more effective lesson plans that cater to diverse student needs.

Overall, this research contributes to the field of biology education by providing empirical evidence on effective teaching practices, highlighting the need for inclusive and resourceful instructional approaches, and offering practical insights that can enhance student learning outcomes.

5.3 Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. Students should be introduced to the use of standardised instructional materials to stimulate learning.
2. There should be training programs to equip teacher with the skills to effective design and implement improvised instructional materials.
3. Teachers and students must break away from the old method of teaching, teaching and learning should be blended and teacher learner centered, if not majorly learner- centered.
4. Educator should ensure to employ gender neutral teaching strategies. This will ensure that both male and female students receive equitable educational opportunities and support their academic success in biology.
5. Teacher should be trained regularly through seminars, workshops and conferences on how to use instructional resources (improvised and standardised) to improve their competence in teaching and learning process.
6. Educator should adopt a blended approach that incorporates improvised instructional materials in teaching biology, to make teaching and learning process interesting.
7. Schools should be equipped with adequate and appropriate technological devices to enhance the teaching of biology with standardised instructional materials.

8. Teacher should avoid gender differences in teaching so that both male and female students benefit equally from the instructional approaches employed.
9. Teachers should ensure adopt the use of instructional materials in teaching and learning process.
10. Government should equipped school with adequate and appropriate technological devices to enhance the teaching of biology to students (males and females) with both improvised and standardised instructional materials.
11. There should be integration of both improvised and standardised instructional materials in teaching to facilitate teaching and learning processes.

5.4 Contributions to Knowledge

Results from this study contribute a great deal to the literature on methods of education, particularly in biology. Some of these contributions are discussed below.

1. Effectiveness of Teaching Strategies: Again, this study has provided empirical evidence on the effectiveness of various teaching strategies such as conventional methods, standardised instructional materials, and improvised instructional materials. This study showed how this blend could lead to an improvement in the academic performance of Senior Secondary School students in biology through the use of such complex topics as the respiratory system.

2. Interaction of Methods of Teaching and Gender on Learning: Employing a 3-way ANOVA, the interaction effect of teaching approaches and learner gender on academic achievement is investigated. This will provide insight into how these variables might interact to influence student outcomes and that the optimal learning in biology is likely to be facilitated by a particular combination of instructional approaches.

3. Gender in Education: The study examines the gender factor related to academic success, and the findings state that the conventional mode of teaching does not make any difference between male and female students. Thus, this helps to motivate educators to practice inclusive teaching to differentially meet student needs irrespective of gender.

4. Use of Improvised Materials: The research insinuates the use of improvised instructional materials within the classroom environment. While proving the fact that such materials, when used with conventional methods, enhance understanding and performance, this study encourages resourcefulness and innovation in teaching by educators.

5. Implication for Future Research: These findings serve as a stepping stone to guide further research into instructional materials and methods of teaching. Other researchers can always continue from the output of this work to survey more variables, for example, special types of improvised materials application or the long-term effects that the combined method application has on student retention and application.

6. Policy Implication: Clearly, the findings of the study can enlighten education policy and also curriculum design to emphasise training for teachers on how to effectively integrate multiple instructional materials into their classrooms to better teaching strategies with greater student engagement and improved learning outcomes in biology and other subjects.

7. Practical Applications: The knowledge gleaned in this research can be put to use by the teachers in the construction of better lesson plans in well-integrated traditional standardised and improvised materials. This will help to meet various learning needs of students with a general improvement in science performance.

8. This study adds to the theoretical understanding of effective teaching strategies in biology education and provides practical recommendations on how instructional practices can be improved to enhance the learning outcomes for students.

5.5 Suggestions for Further Research

Based on the findings of this study, the following recommendations for future research are proposed:

1. Longitudinal Studies: Longitudinal designs might be employed in the future in studying the long-term effects of both standardised and improvised teaching materials on student academic achievement in different subjects and topics to bring out the lasting effectiveness of the observed impacts.

2. Comparative Analysis of Instructional Materials: Variation in instructional materials-like digital-print combinations-should make a differential impact on the academic performance, engagement, and motivation of students. Such a comparison will help in terms of best solutions for specific contexts in education.

3. Effects of Teacher Training Programs: It would be very informative to analyse how a teacher training program focused on the elaboration and use of improvised instructional resources affects teaching efficiency and students' performance that will give the valuable suggestions on how to develop professional preparation training programs.

4. Varied Geographical and Socioeconomic Contexts: This would help in ascertaining whether the findings are regular across different settings, a comparison of findings in rural versus urban schools, or within different cultural contexts.

5. Student-centered approaches: This would, therefore, translate to the fact that student-centered teaching methods, such as collaborative learning and project-based learning combined with standardised and improvised resources, might be useful for developing an understanding of how to effectively foster active learning and critical thinking in biology education.

Bibliography

Chapters in Books

Brau. B, *Constructivism. In R. Kimmons, & S. Caskurlu (Eds.), The Students' Guide to Learning Design and Research*, EdTech Books. 2020, https://edtechbooks.org/studentguide/constructivism.

Spinola. O. A, Garrido. V, Teixeira. M. M, Salles. C & Haddad. A. E, *Influence of Learning styles on Student Performance in Self-Instructional Courses,* National Library of Medicine Science, 18(7), 2023.

Journals

Abalas D.G., Andrew K.L. & Abifarin M.S., *Effects of Simulation Strategy Senior Secondary Two Biology Students' Interest and Academic Achievement in Plateau Northern Senatorial Zone, Nigeria*, **International Journal of Research and Innovation in Social Science (IJRISS)**, 6(12), 2022, 60-64.

Abdulrahaman M.D., Faruk N., Oloyede A.A., Surajudeen-Bakinde N.T., Olawoyin L.A., Mejabi O.V., Imam-Fulani Y.O., Fahm A.O. & Azeez A.L., *Multimedia tools in the teaching and learning processes: A systematic review.* ***Heliyon*****,** *6*(11), 2020 e05312. Available online: https://doi.org/10.1016/j.heliyon.2020.e05312.

Abidoye F.O. & Abidoye A.O., *Analysis of effect of science instructional materials on students' academic performance in Ilorin-West, Kwara State*, **Edu Basic Journal: Journal Pendidikan Dasar**, 5(1), 2023, 1-10.

Abidoye O., Abidoye A. & Malik O., *The Effect of Biology Teaching Materials on the Academic Performance of Senior Secondary School Students in Ilorin West, Ilorin, Kwara State*, **International Journal of Educational Innovation and Research**, 2(1), 2023, 142-150.

Acosta N., *Development and Validation of Grade 10 Science Learning Materials in Selected Secondary Schools in District iii, Division of Puerto Princesa City, Philippines,* **Journal of Educational Research in Developing Areas**, 1(3), 2020, 248-264.

Adebola T., & Oladipo K., *Effects of Urban Air Pollution on Asthma Prevalence and Severity in Children in Lagos.* **Nigerian Journal of Pediatric Health**, 14(3), 2022, 198-210.

Adesola M.O., Olorode G.B. & Ranmolate T.R., *Effect of Instructional Materials on Biology Instructions among High Achieving Secondary School Students in SPED International Secondary School, Oyo, Nigeri*a, **Journal of Educational Research in Developing Areas**; 3 (2), 2022, 237-245.

Adeyemi K. & Adeyemi T., *Teacher-Student Relationships and Academic Outcomes in Ogun State*, **Nigerian Journal of Educational Psychology**, 29(1), 2022, 56-72.

Agboghoroma T. E & Oyovwi E. O., *Evaluating Effect of Students' Academic Achievement on Identified Difficult Concepts in Senior Secondary School Biology in Delta State.* **Journal of Education and Practice**, 6, (30), 2015, 117- 125

Akinwumi I.O., *Effect of Inquiry Method on the Academic Achievement of Senior Secondary School Students in Biology in Ondo State, Nigeria*, **Himalayan Journal of Education and Literature,** 3 (5), 2022, 185-190.

Anthony A., *Instructional Design Standards for Distance Learning*. 2017. Available online: https://members.aect.org/publications/designstandards/DL_Design_Standards.pdf.

Anyakaorah D.C., *Improvisation of Instructional Materials for Effective Teaching and Learning of Computer in Junior Secondary Schools In Ebonyi State*, **Unizik Journal of Educational Research and Policy Studies**, 8 (5), 2021, 20-29.

Bello M. & Adeola S., *Utilization of Multimedia Presentations in Teaching Complex Concepts in Tertiary Institutions in Ogun State*, **Nigerian Journal of Higher Education**, 21(1), 2023, 95-110.

Berhanu M. & Sheferaw H., *The Effectiveness of Guided Inquiry-Based Learning Strategy on Learning Physical and Chemical Changes*, **African Journal of Chemical Education**, 12(2), 2022, 149 – 185.

Cathy H., Stijn S., Nicolas D., Lot F., Arnaud S. & Wouter D., *Interactions of Gender with Predictors of Academic Achievement,* **Contemporary Educational Psychology**, 2023, 74. 10.1016/j.cedpsych.2023.102186.

Damilola O. & Olaoye O., *Paradigm Shift in Educational Assessment: Formative Assessment as a Pointer to Educational Reform in Nigeria School System,* **Lafiagi Journal of Science, Technical and Vocational Education,** 2(1), 2021, 91-106.

Daniel M., Alphonse R. & Twizeyimana E., *Conceptual Understanding of Improvised Instructional Materials through Teachers' Perception of their Availability and Implication in Science Teaching and Learning Endeavors in the Southern Province of Rwanda,* **Journal of Global Research in Education and Social Science,** 14(2), 2020, 67-77.

Ebele F. & Abubakar Z., *Effects of Group Investigation Strategy on Secondary School Students' Academic Achievement in Biology in Kwali Educational Zone of FCT-Abuja,* **International Journal of Innovative Research & Development**, 8 (12), 2019, 113-119.

Eric O., *Effects of Improvised Instructional Materials on Senior Secondary School Students' Academic Achievement and Interest in Mathematics in Enugu East Local Government Area Enugu State, Nigeria*, **Journal of Research in Science and Vocational Education (JRSVE),** 3(1), 2023, 115-123.

Eseine- Aloja C. E., *Effects of Gender on the Academic Performance of Public- School Biology Students Participating in School Organised Extra-Mural Classes*, **Sapientia Foundation Journal of Education, Sciences and Gender Studies (SFJESGS)**, 3, (1), 2021, 337 – 349.

Etop E.S., Iboro S.G. & Obogo A.S., *Influence of Locally Available Instructional Materials on Biology Students' Academic Achievement in Abak Local Government Area of Akwa Ibom state, Nigeria*, **Global journal of educational research,** 22(1), 2023, 81-87.

Eze N. & Musa J., *Personalized Learning Approaches in Maximizing Learning Outcomes in Biology,* **Nigerian Journal of Educational Studies**, 19(3), 2022, 178-192.

Ezechi N. G., *Effect of Improvised Instructional Materials on Senior Secondary Students' School Achievement in Biology in Enugu South Loca Government Area Of Enugu State*, Nigeria, **International Journal of Engineering, Science Mathematics**, 8 (3), 2019, 53 – 61.

Ezeliora B.A., Ibe F. N. & Chukwunazo O. M., *Comparative Effects of Teaching with Improvised Instructional Materials and Standard Instructional Materials on Secondary School Students' Academic Achievement In Chemistry,* **International Journal of Research in Education and Sustainable Development,** 1, 2021, 27-40.

Gabriel I., Geoffrey A. & Wisdom T., *Effect of Teacher-Learner Improvised Material on Creative Thinking Among Varied-Ability Upper Basic Science Students in Makurdi Metropolis*, **Journal of Science Technology**, 2(1), 2022, 72 - 80.

Harrison M., *Effect of the Use of Instructional Materials on Students' Academic Achievement in the Concept of Respiratory System*, 2023, Available online: https://researchkings.com.ng/2023/12/08/effect-of-the-use-of-instructional-materials-on-students-academic-achievement-in-the-concept-of-respiratory-system/.

Isma'il A. & Lukman O., *Availability and Utilization of Instructional Materials in Teaching and Learning of Biology in Senior Secondary Schools*, **Academia**, 6 (2), 2022, 1-8.

Julius A. & Michelle K., *Measuring Education System Coherence: Alignment of Curriculum Standards, Examinations, and Teacher Instruction in Tanzania and Uganda,* **International Journal of Educational Development,** 9(1), 2022.

Kelp N.C., McCartney M., Sarvary M.A., Shaffer J.F. & Wolyniak M.J., *Developing Science Literacy in Students and Society: Theory, Research, and Practice,* **Journal of Microbiology & Biology Education,** 24(2), 2023. Available online: https://doi.org/10.1128/jmbe.00058-23.

Kurup A.R. & Underwood M.K., *Gender Diversity in Peer Relations: Best Research Practices and Marshalling Peer Influence*, **Journal of Applied Developmental Psychology**, *76*, 2021, 101328, https://doi.org/10.1016/j.appdev.

Makinde S.O. & Abdulsalam A.B., *Perceived Influence of Learning Resources Availability and Utilization on Senior Secondary School Student's Performance in Biology in Ilorin Metropolis*, **Nigerian Online Journal of Educational Sciences and Technology (NOJEST)**, 4 (2), 2022, 71-79.

Mokoro D.K., *Adequacy of Laboratory Facilities for Effective Implementation of Competence- Based Curriculum in Public Secondary Schools in Arumeru District, Tanzania,* **East African Journal of Education and Social Sciences,** 1(2), 2020, 141-149.

Moses V.U., *Influence of Instructional Materials on Students' Academic Performance in Biology in Calabar South Local Government Area, Cross River State*. Available online: https://ssrn.com/abstract=3531233, 2020, 1-50.

Muhoza R.N., Imaniriho D., Nshimiyimana A., E. Nkunzabo, N. J. Ntezimana & P. N. Batera, *The Effect of Teaching Aids on Students' Performance in Biology Subject in O'level Secondary Schools in Kayonza District*, **Journal of Research Innovation and Implications in Education**, 7(2), 2023, 124 – 133.

Mukagihana J., Nsanganwimana F. & Aurah C.M., *Biology Instructional Resources Availability and Extent of their Utilization in Teaching Pre-Service Biology Teachers*, **African Journal of Educational Studies in Mathematics and Sciences**, 16 (2), 2020, 33-50.

Munna A.S. & Kalam M.A., *Teaching and Learning Process to Enhance Teaching Effectiveness: a Literature Review*, **International Journal of Humanities and Innovation (IJHI),** 4 (1), 2021, 1-4.

Mushimiyimana D., Kampire E. & Dushimimana E., *Impacts of Improvised Instructional Materials on Grade Nine Learners' Performance in Chemistry*, **African Journal of Educational Studies in Mathematics and Sciences,** 18(1), 2022, 127 – 135.

Nja C. & Obi J., *Effect of Improvised Instructional Materials on Academic Achievement of SS1 Chemistry Students in Cross River State Nigeria*, **International Journal of Applied Research**, 5(7), 2019, 444-448.

Nwoke B.I. & Nwaneri O.M., *Effect of Improvised Instructional Materials on Senior Secondary School Students Achievement and Retention in Mathematics*, **The International Technology Management Review**, 4 (1), 2016, 1-9.

Nwosu C. & Okonkwo E., *Effectiveness of Instructional Materials in Facilitating Formative Assessment Practices in Nigerian Educational Settings*, **Nigerian Journal of Educational Psychology**, 19(1), 2021, 75-88.

Nwosu C. & Okonkwo E., *Role of technology-Enhanced Teaching Methods in Promoting Deeper Understanding among Nigerian Students,* **Nigerian Journal of Curriculum Studies**, 19(1), 2021, 75-88.

Nwosu C., & Okonkwo E., *Differential Effects of Instructional Materials on Students' Academic Performance and Interest in Geography: Evidence from Nigerian Secondary Schools,* **Nigerian Journal of Curriculum Studies**, 19(1), 2021, 75-88.

Nwosu I., Eze P. & Obasi C., *Impact of Ethnic and Cultural Background on Gender Disparities in Biology Achievement in Delta State,* **Nigerian Journal of Multicultural Education**, 17(2), 2021, 98-113.

Obiukwu O., Kingsley U., Johnson O., Enoch L., Odinakachi E., Mbalisi O. & Leonard J., *Accessibility of Instructional Materials for Effective Teaching: Outlook from High Schools in Eleme, River State, Nigeria*, **Cypriot Journal of Educational Sciences,** 18. 456-469. 2023.

Okafor C., *Challenges of Using Printed Textbooks in Rapidly Changing Fields: A Case Study of Information Technology and Environmental Science,* **Nigerian Journal of Educational Technology**, 15(2), 2021, 142-156.

Okafor U. & Adekunle B., *Impact of parental involvement on the academic performance of secondary school students in Abuja,* **Nigerian Journal of Educational Research**, 20(3), 2023, 112-128.

Okori O.A. & Jerry O., *Improvisation and Utilization of Resources in the Teaching and Learning of Science and Mathematics in Secondary Schools in Cross River State*, **Global Journal of Educational Research**, 16, 2017 21-28.

Olawale M.Y., *Effect Of Improvised Instructional Materials On Biology Practical Skills Acquisition In Senior Secondary Schools In Lagos State*, **Port Harcourt Journal of Educational Studies,** 5(3), 2020, 136-200.

Oluwaseun K., Adeola F. & Chidi E., *Microbial Communities and Ecological Balance in Nigerian Ecosystems*, **Nigerian Journal of Microbial Ecology**, 19(2), 2021, 101-118.

Omoshola A., Abidoye A. & Malik O., *The Effect of Biology Teaching Materials on the Academic Performance of Senior Secondary School Students in Ilorin West, Ilorin, Kwara State*, **International Journal of Educational Innovation and Research,** 2(1), 2023, 142-150.

Owolabi A.M., Olorode G.B. & T. R. Aranmolate, *Effect of Instructional Materials on Biology Instructions Among High Achieving Secondary School Students in SPED International Secondary School, Oyo, Nigeria*, **Journal of Educational Research in Developing Areas**, 3(2), 2022, 237-245.

Ozcan M., *Factors Affecting Students' According to the Teachers' Opinion Academic Achievement*, **Education Reform Journal,** 6 (1), 2021, 1-18.

Saleem A., Kausar H. & Deeba F., *Social Constructivism: A New Paradigm in Teaching and Learning Environment*, **Perennial Journal of History**, 2, 2021, 403-421.

Shaibu J.S., Shuaibu K., Obaje A.F. & Atawodi I., *Improvisation of Instructional Materials: A Veritable Option in the Teaching and Learning of Social Studies in Secondary Schools, Kogi State, Nigeria*, **IOSR Journal Of Humanities And Social Science (IOSR-JHSS)**, 28 (5); 2023, 15-21.

Umuhoza C. & Uworwabayeho A., *Teacher's Use of Instructional Materials in Teaching and Learning Mathematics in Rwandan Primary Schools*, **African Journal of Teacher Education**, 10 (2), 2021, 1-16.

Usendu U.U., Babayemi J.O., Uko P.J. & Umoetuk E.U., *Effect of Improvised Neuron Model and School Location on Senior Secondary School Students' Academic Achievement in Biology*, **International Journal of Developmental Research in Education (IJDRE),** 3 (1), 2023, 130-142.

Yusuf A. & Adewale T, *Role of Socio-Emotional Competencies in Predicting Academic Success Among Secondary School Students in Kano*, **Nigerian Journal of Educational Psychology**, 21(4), 2023, 210-225.

Periodical

Bright N., *Effect of Improvised Instructional Materials on Senior Secondary School Students Achievement and Retention in Mathematics*, The International Technology Management Review. 4, 2020, 1-9.

Evans E., *Political Intersectionality and Disability Activism: Approaching and Understanding Difference and Unity*, The Sociological Review, 70(5), 2022, 986-1004.

Momsen J., Speth E.B., Wyse S. & Long T., *Using Systems and Systems Thinking to Unify Biology Education,* CBE Life Sciences Education, 21(2), 2022. Available online: https://doi.org/10.1187/cbe.21-05-0118.

Thesis

Ekineh D. & Adolphus T., *Influence of Gender on Students' Performance in Biology when Taught Reproduction Using Collaborative Strategy in Secondary Schools in Rivers State*, 2019, 62-73.

Husman H., *Effects of Physical and Virtual Laboratories on Learning Outcomes in Geography among Senior Secondary School Students in North Central Nigeria,* PhD Thesis, Department of Educational Technology, Federal University of Technology Minna, 2021. Available online: http://repository.futminna.edu.ng:8080/jspui/bitstream/123456789/14529/1/PhD%20USMAN%20Hussaini.pdf 2021.

Websites

Akinola D. & Dichaba M., *Lifelong Learning and Career Progression of Women in Nigeria*. 2021. Available online: 10.1007/978-3-030-44217-0_18. 2021.

Britannica T., *Larynx*, Encyclopedia Britannica. Available online: https://www.britannica.com/science/larynx. 2023.

Drinko C., *Benefits of Improvisation in the Classroom*, 2020. Available online: https://www.playyourwaysane.com/blog/benefits-of-improvisation-in-the-classroom.

Green E. R., Heyner J. S. & Kara R., *Biology*, Encyclopedia Britannica, 2024. Available online: *https://www.britannica.com/science/biology.*

Jeffrey C., Mcduffie A., Drake C. & Davis J., *The Role of Instructional Materials in the Relationship between the Official Curriculum and the Enacted Curriculum. Mathematical Thinking and Learning, 24*, 2020. Available online: https://doi.org/10.1080/10986065.2020.1855376.

Lukman D., *How Improvisation of Instructional Materials Can Influence Students Academic Achievement,* 2021. Available online**:** https://imperialwriters7.medium.com/how-improvisation-of-instructional-materials-can-influence-students-academic-achievement-ae958138ae2b .

Lukman D., *Instructional Materials, Teaching Methods and Students' Performance*, 2021. Available online: https://imperialwriters7.medium.com/instructional-materials-teaching-methods-and-students-performance-754e38d8709c.

Mcleod S., *Constructivism Learning Theory & Philosophy of Education*, 2024. Available online: https://www.simplypsychology.org/constructivism.html.

Michael B., Randy L., Kevin K., Hodges C., Moore S., Barbara L., Torrey T. & Mark B., *Understanding Pandemic Pedagogy: Differences Between Emergency Remote, Remote, and Online Teaching*, 10.13140/RG.2.2.31848.70401. 2020.

Moses V. U., *Influence of Instructional Materials on Students' Academic Performance in Biology in Calabar South Local Government Area, Cross River State*, 2020, 1-50. Available online: https://ssrn.com/abstract=3531233.

Nicolò A., Massaroni C., Schena E. & Sacchetti M., *The Importance of Respiratory Rate Monitoring: From Healthcare to Sport and Exercise, Sensors (Basel, Switzerland)*, 2020, *20*(21), 6396. Available online: https://doi.org/10.3390/s20216396. 2020.

Ordoñez T., Lorenzo S., Ordoñez T. & Concepcion M., *The Scope of Biotechnology in the 21st Century*, 2023. *Available Online:* file:///C:/Users/HomePC/Downloads/TheScopeof Biotechnologyinthe21stCentury.pdf.

Appendix I
Lead City University, Ibadan
Department of Science Education
Biology Achievement Test (BAT)
Multiple Choice Objectives Questions (Pre-Test)

Instructions:

In Section A: Please provide an appropriate answer to the following questions

In Section B: Please shade only one answer at a time from the given options

Duration: 20 minutes

Section A

Demographic Characteristics of Participants

School Name: _____

Gender: Male ☐ Female ☐

Class: _____

Section B

1. One of these is not part of the respiratory system.

A. Gas exchange organs

B. Lung

C. Structures\ surfaces

D. Kidney

E. Mitochondrion

2. Respiration is an essential life process providing the living cell with

A. Oxygen

B. Sugar

C. Energy

D. Carbon dioxide

E. Water

3. The thoracic cavity is separated from the abdominal cavity by.

A. Pleural membrane

B. Intercostal muscle

C. Diaphragm

D. Pericardium

E. Epiglottis

4. Breathing movement in mammals is accompanied by regular movements of the diaphragm and the

A. Intercostal muscles

B. Vertebral column

C. Clavicle

D. Pleural cavity

E. Floating ribs

5. In the adult toad, gaseous exchange takes place through the

A. Buccal cavity, skin and spiracle.

B. Lympanic membrane, lungs and gill.

C. Buccal cavity, skin and lungs.

D. Buccal cavity, skin and lungs

E. Gills, skin and buccal cavity.

6. The respiratory organ found in the cockroach is the

A. Air sac

B. Trachea

C. Lung book

D. Lung

E. Gill

7. The metabolic process which takes place in living cells by which organic nutrients are broken down to release energy or ATP for life activities is

A. Respiration

B. Photosynthesis

C. Excretion

D. Transpiration

E. Digestion

8. Which of the following does not occur during inhalation in mammals?

A. Rib cage is raised up

B. Diaphragm contracts and becomes dome shaped.

C. Intercostal muscle contracts.

D. Bronchus is raised up

E. Volume of thoracic cavity increases

9. The effect of contraction of the muscles of the diaphragm is that

A. The volume of the thoracic cavity increases.

B. More carbondioxide is expelled through the nosrils.

C. The rib cage is drawn inward.

D. The intercostal muscles becomes relaxed.

E. The volume of the thoracic cavity is decrease.

10. Which part of the gill of fish is involved in gaseous exchange?

A. Gill slits

B. Gill bars

C. Govers

D. Gill filaments

E. Gill rack

11. Amoeba obtains all its oxygen requirements

A. From oxidizing food substances

B. From air trapped in vacuoles

C. Through diffusion of air into its body.

D. Through an air cavity in the ectoplasm.

E. Through endoplasm

12. Which of the following organisms respires through the body surface

A. Man

B. Fish

C. Tridax

D. Cockroach

E. Amoeba

13. The movement of the diaphragm is characteristics of gaseous exchange in

A. Insects

A. Fish

C. Toad

D. Mammals

E. Plants

14. In cellular respiration, energy is stored in the form of

A. Adenosine diphosphate (ADP)

B. Adenosine monophosphate (AMP)

C. Adenosine triphosphate (ATP)

D. Heat energy

E. Electric energy

15. During the process of breathing, volume and pressure changes occur as a result of the movement of the .

A. Diaphragm and Intercostal muscles

B. Larynx and Trachea

C. Thoracic cavity and Bronchus

D. Lungs and Epiglottis

E. Oesophagus and Bronchi

16. The respiratory organ found in the cockroach is the

A. Air sac

B. Trachea

C. Lung book

D. Lung

E. Gill

17. The products of respiration are

A. Nitrogen and water

B. Nitrogen and Carbon dioxide

C. Water and Oxygen

D. Carbon dioxide and Water

E. Oxygen and Carbon dioxide

18. ---------- refers to the surrounding of the organism from which it obtains oxygen

A. Respiratory organ

B. Transport medium

C. Respiratory medium

D. Ventilation

E. Respiratory surface

19. Which of the following statements is not correct of respiration.

A. Gaseous exchange occurs by diffusion

B. Oxygen combines with haemoglobin at the respiratory surface

C. Carbon dioxide produced in the tissues removed by the process of osmosis

D. There are no special organs for respiration in plants

E. In higher animals, respiratory gases are transported in solution

20. In breathing mechanism in animals, balloons are equivalent to

A. Lungs

B. Diaphragm

C. Rib cage

D. Trachea

E. Larynx

Appendix II
Lead City University, Ibadan
Department of Science Education
Biology Achievement Test (BAT)
Multiple Choice Objectives Marking Guide (Pre-test)

1. D
2. C
3. C
4. A
5. C
6. B
7. A
8. B
9. A
10. D
11. C
12. E
13. D
14. C
15. A
16. B
17. D
18. C
19. C
20. A

Appendix III
Lead City University, Ibadan
Department of Science Education
Biology Achievement Test (BAT)
Multiple Choice Objectives Questions (Post-Test)

Instructions:

In Section A: Please provide an appropriate answer to the following questions

In Section B: Please shade only one answer at a time from the given options

Duration: 20 minutes

Section A

Demographic Characteristics of Participants

School Name: _____

Gender: Male ☐ Female ☐

Class: _____

Section B

1. One of these is not part of the respiratory system.

A. Gas exchange organs

B. Lung

C. Structures\ surfaces

D. Kidney

E. Mitochondrion

2. Respiration is an essential life process providing the living cell with

A. Oxygen

B. Sugar

C. Energy

D. Carbon dioxide

E. Water

3. The thoracic cavity is separated from the abdominal cavity by.

A. Pleural membrane

B. Intercostal muscle

C. Diaphragm

D. Pericardium

E. Epiglottis

4. Breathing movement in mammals is accompanied by regular movements of the diaphragm and the

A. Intercostal muscles

B. Vertebral column

C. Clavicle

D. Pleural cavity

E. Floating ribs

5. In the adult toad, gaseous exchange takes place through the

A. Buccal cavity, skin and spiracle.

B. Lympanic membrane, lungs and gill.

C. Buccal cavity, skin and lungs.

D. Buccal cavity, skin and lungs

E. Gills, skin and buccal cavity.

6. The respiratory organ found in the cockroach is the

A. Air sac

B. Trachea

C. Lung book

D. Lung

E. Gill

7. The metabolic process which takes place in living cells by which organic nutrients are broken down to release energy or ATP for life activities is

A. Respiration

B. Photosynthesis

C. Excretion

D. Transpiration

E. Digestion

8. Which of the following does not occur during inhalation in mammals?

A. Rib cage is raised up

B. Diaphragm contracts and becomes dome shaped.

C. Intercostal muscle contracts.

D. Bronchus is raised up

E. Volume of thoracic cavity increases

9. The effect of contraction of the muscles of the diaphragm is that

A. The volume of the thoracic cavity increases.

B. More carbondioxide is expelled through the nosrils.

C. The rib cage is drawn inward.

D. The intercostal muscles becomes relaxed.

E. The volume of the thoracic cavity is decrease.

10. Which part of the gill of fish is involved in gaseous exchange?

A. Gill slits

B. Gill bars

C. Govers

D. Gill filaments

E. Gill rack

11. Amoeba obtains all its oxygen requirements

A. From oxidizing food substances

B. From air trapped in vacuoles

C. Through diffusion of air into its body.

D. Through an air cavity in the ectoplasm.

E. Through endoplasm

12. Which of the following organisms respires through the body surface

A. Man

B. Fish

C. Tridax

D. Cockroach

E. Amoeba

13. The movement of the diaphragm is characteristics of gaseous exchange in

A. Insects

A. Fish

C. Toad

D. Mammals

E. Plants

14. In cellular respiration, energy is stored in the form of

A. Adenosine diphosphate (ADP)

B. Adenosine monophosphate (AMP)

C. Adenosine triphosphate (ATP)

D. Heat energy

E. Electric energy

15. During the process of breathing, volume and pressure changes occur as a result of the movement of the .

A. Diaphragm and Intercostal muscles

B. Larynx and Trachea

C. Thoracic cavity and Bronchus

D. Lungs and Epiglottis

E. Oesophagus and Bronchi

16. The respiratory organ found in the cockroach is the

A. Air sac

B. Trachea

C. Lung book

D. Lung

E. Gill

17. The products of respiration are

A. Nitrogen and water

B. Nitrogen and Carbon dioxide

C. Water and Oxygen

D. Carbon dioxide and Water

E. Oxygen and Carbon dioxide

18. ---------- refers to the surrounding of the organism from which it obtains oxygen

A. Respiratory organ

B. Transport medium

C. Respiratory medium

D. Ventilation

E. Respiratory surface

19. Which of the following statements is not correct of respiration.

A. Gaseous exchange occurs by diffusion

B. Oxygen combines with haemoglobin at the respiratory surface

C. Carbon dioxide produced in the tissues removed by the process of osmosis

D. There are no special organs for respiration in plants

E. In higher animals, respiratory gases are transported in solution

20. In breathing mechanism in animals, balloons are equivalent to

A. Lungs

B. Diaphragm

C. Rib cage

D. Trachea

E. Larynx

Appendix IV
Lead City University, Ibadan
Department of Science Education
Biology Achievement Test (BAT)
Multiple Choice Objectives Marking Guide (Post-test)

1. D
2. C
3. C
4. A
5. C
6. B
7. A
8. B
9. A
10. D
11. C
12. E
13. D
14. C
15. A
16. B
17. D
18. C
19. C
20. A

Appendix V
Biology Lesson Note for Intervention group A
Lesson Note I
Lesson for Teaching Respiratory System Using Improvised Instructional Materials

Class Information

Class: SS 2

Subject: Biology

Topic: Respiratory System

Sub-Topic: Gaseous Exchange

Duration: 80 Minutes

Instructional Materials: Plastic jar, straw, balloons, rubber sheet, tape, rubber bands, scissors

Reference Book: Eluwa, M. W. & Soyibo, K.O. (2003). *Countdown to Senior Secondary Certificate Examination*. Ibadan: Evans Brothers Limited, pp. 90-100

Instructional Objectives

By the end of this lesson, students should be able to:

1. Explain the concept of the respiratory system.
2. Identify the primary organs of the respiratory system.
3. Compare the anatomical structures of the mammalian respiratory system to a lung model created using a plastic jar, straw, balloon, and rubber sheet.

Entry Behavior

Students should already be familiar with basic terminologies and concepts related to the respiratory system.

Lesson Presentation

Step One: Introduction to the Respiratory System

Begin the lesson by discussing respiration as a biological process. Explain that respiration involves the breakdown of organic compounds, such as simple sugars, by enzymes, leading to the release of energy. This process can occur in two forms:

- **Aerobic Respiration:** Occurs in the presence of oxygen.
- **Anaerobic Respiration:** Occurs in the absence of oxygen.

Next, introduce the various organs and structures involved in gas exchange, emphasizing the role of mitochondria within cells as sites of energy production.

Appendix VI
Biology Lesson Note for Intervention group B
Lesson Note II
Lesson for Teaching Respiratory System Using Standardised Instructional Materials

- **Class:** SS 2
- **Subject:** Biology
- **Topic:** Respiratory System
- **Sub-Topic:** Exchange of Gas in Mammals
- **Duration:** 80 Minutes
- **Instructional Materials:** Projector (to demonstrate gas exchange in mammals)
- **Reference Book:** Eluwa, M. W. & Soyibo, K.O. (2003). *Countdown to Senior Secondary Certificate Examination*. Ibadan: Evans Brothers Limited, pp. 90-100

Instructional Objectives

By the end of the lesson, students should be able to:

1. Define gaseous exchange.
2. Identify the gas exchange devices used in the respiratory system.
3. Differentiate between the changes that occur in each respiratory organ during inhalation and exhalation.

Entry Behavior

Students should already be familiar with some basic terms related to the respiratory system.

Lesson Presentation

Step 1: Introduction to Gaseous Exchange

The teacher begins by explaining the concept of gaseous exchange.

- **Definition:** Gaseous exchange is the process through which an organism expels gases from its body cells and takes in air from its external environment. The primary organ responsible for this exchange is known as a gas exchange organ.

Step 2: Identification of Gas Exchange Devices

The teacher highlights the main devices used for gas exchange in the respiratory systems of mammals:

1. Trachea (windpipe)
2. Lungs
3. Diaphragm
4. Larynx (can be represented by the tip of a straw)
5. Pharynx
6. Thorax

Step 3: Demonstration of Breathing Mechanisms

The teacher projects visuals to illustrate how the main gas exchange devices function during inhalation and exhalation in mammals (specifically humans).

- **Two Stages of Breathing in Mammals:**

- **Inhalation:**
    - When a mammal inhales, the intercostal muscles contract, raising the rib cage. The diaphragm contracts and flattens, which increases the volume of the thoracic cavity and decreases its pressure. This difference in pressure allows atmospheric air to flow into the lungs through the nostrils and air passages.
- **Exhalation:**
    - During exhalation, the intercostal muscles relax, and the rib cage lowers. The diaphragm relaxes and returns to its dome shape. This decreases the volume of the thoracic cavity, causing the lungs to contract and increasing air pressure inside the lungs, which forces air out through the air passages.

Evaluation

Students will be assessed on their understanding through the following:

1. Define gaseous exchange.
2. Identify gas exchange devices in the respiratory system.
3. Describe the changes in each respiratory organ during inhalation and exhalation.

Conclusion

The teacher summarizes the lesson, providing additional explanations on what occurs in various respiratory organs during inhalation and exhalation.

Assignment

Explain the changes that occur in the intercostal muscles, rib cage, and diaphragm when air enters through the windpipe.

Appendix VII
Biology Lesson Note for Lesson Control Group
Lesson Note III
Lesson for Teaching Respiratory System Using Conventional Method

- **Class:** SS 2
- **Subject:** Biology
- **Topic:** Respiratory System
- **Sub-Topic:** Exchange of Gas in Mammals
- **Duration:** 60 Minutes
- **Reference Book:** Eluwa, M. W. & Soyibo, K. O. (2003). *Countdown to Senior Secondary Certificate Examination*. Ibadan: Evans Brothers Limited, pp. 90-100

Instructional Objectives

By the end of the class, students should be able to:

1. Understand the concept of the respiratory system and gaseous exchange.
2. Discuss the gas exchange devices in the respiratory system.
3. Explain the effects of inhalation and exhalation on each respiratory organ.

Entry Behavior

Students should already be familiar with certain terminology related to the respiratory system.

Presentation

The teacher will present the lesson as follows:

Step 1: Introduction to the Respiratory System

- **Definition:** The respiratory system is a biological system that enables the exchange of gases in living organisms. It involves enzymes that release energy from organic nutrients, such as simple sugars, both in the presence (aerobic) and absence (anaerobic) of oxygen. The system comprises gas exchange organs, structural surfaces, and mitochondria present in all living cells.
- **Gas Exchange:** Gas exchange is the process by which organisms expel carbon dioxide and other gases from their body cells while inhaling oxygen-rich air from the surrounding environment. The gas exchange organs are the primary structures involved in this process.

Step 2: Key Gas Exchange Devices in Mammals

The teacher highlights the main gas exchange devices in the respiratory systems of mammals:

1. **Trachea (windpipe)**
2. **Lungs**
3. **Diaphragm**
4. **Larynx** (can be represented by the tip of a straw)
5. **Pharynx**
6. **Thorax**

Step 3: Mechanisms of Breathing in Mammals

The teacher describes how the primary gas exchange devices function during inhalation and exhalation in humans:

- **Inhalation:** When a mammal inhales, the intercostal muscles contract, raising the rib cage. The diaphragm contracts and flattens, increasing the volume of the thoracic cavity and decreasing the pressure inside. This pressure difference causes a large volume of air to be drawn into the lungs through the nostrils and air passages.
- **Exhalation:** During exhalation, the intercostal muscles relax, and the rib cage lowers. The diaphragm also relaxes, returning to its dome shape. This decreases the volume of the thoracic cavity, causing the lungs to contract and increasing the air pressure inside the lungs, which forces air out through the air passages.

Evaluation

Students will be assessed through the following questions:

1. Define the respiratory system.
2. Define gaseous exchange.
3. Discuss the gas exchange devices utilized in the respiratory system.
4. Explain the effects of inhalation and exhalation on each respiratory organ.

Conclusion

The teacher summarizes the session by providing additional insights into the functions of the lungs during the breathing process.

Assignment

Explain what happens to the intercostal muscles, rib cage, and diaphragm when air enters the windpipe.

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- University of Ado Ekiti, Ekiti, Nigeria 2004 – 2009

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- Primary School Leaving Certificate 1992

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Publications:

Articles in Learned Journals

Olajide R.D., Oluwatuberu, A.O., **Hamzat, S.T.** & Oyeyinka, A.J (2021). Health Implication of Chemical Containments and it's influence on Academic Performance of Senior Secondary School Students in Afijio Local Government Area of Oyo State. Journal of Multidisciplinary Studies, (JJMS), 4(1), 117-182.

Animasahun, V.O., Adeyemi, M. I. & **Hamzat, S. T** (2021). Core Variables. Predicting aparthy to science education among secondary school students in Ibadan metropolis.

Adeyanju S.T., Ogunrinde R.I. & Ibiyemi D.J. (2024). Impact of Internet Addiction on Academic Performance of Biology Students in Tertiary Institutions in Odeda Local Government Area of Ogun State.

Chapters Contribution in Books

Animasahun, V.O., Adeyemi, M. I. & **Hamzat, S. T** (2022). Science Students Perception on Virtual Learning and its Impacts on Academic Performance in Federal College of Education (Special), Oyo. A book of Reading in Honour of Mr. R.O. Tijani.

Animasahun, V.O., Adeyemi, M. I. and **Adeyanju, S. T** (2023). A Catalyst for Improved Quality Leadership in Science Education. A Book of Reading in Honour of Professor K.O. Usman.

Animasahun, V.O., Adeyemi, M. I., **Adeyanju, S. T** & Adeyemi C.O. (2023). Leadership Ethics and Organizational Improvement in Science Education. A Book of Reading in Honour of Professor K.O. Usman.

Attendance at learned Conferences / Seminars and Workshops including titles of paper(s) presented:

- Delivery of an Effective Academic Lecture With Power Point. A two- Day Workshop organized by Centre for Educational Technology at the Federal College of Education (Special), Oyo, 3rd – 4th August, 2021.
- Economic Adjustment for Better Life by Civil Servants in Post Covid-19 Era. A One-Day Workshop by Women in Colleges of Education (WICE) at Federal College of Education (Special), Oyo, 19th August, 2021.
- Animasahun, V.O., Adeyemi, M.I., and **Hamzat, S.T (2022).** Psychosocial Factors of Spousal Rape among Science Educator Women in Colleges of Education in Southwest Nigeria: Implications on National Growth and Development. Federal College of Education (Special), Oyo. 7th – 11th March.
- Animasahun, V.O., Adeyemi, M.I., and **Hamzat, S.T** (2022). Stem a Catalyst for N National Unity, security and Economic Development. 9th Biennial National Conference, School of Secondary Education (Science Programmes), Federal College of Education (Special), Oyo. 6th – 9th June.
- Animasahun, V. O., Adeyemi, M.I .and **Hamzat, S.T** (2022). Perceived Science Lecturers' Competency and Students' Attitude to Implementation of Stem Education in Federal College of Education (Special) Oyo. 9th Biennial National Conference, School of Secondary Education (Science Programmes), Federal College of Education (Special), Oyo, 6th -9th, June.

- Financial Planning in a Cashless Society: Challenges and Way Forward. A- Day Workshop Organized by Association of Women in Colleges of Education (WICE) SPED Chapter. Held at Federal College of Education (Special), Oyo. 4th May, 2023.

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The University Compliance Form

This is to certify that the thesis by Saudat Titilope, ADEYANJU in the Department of Science

Education, Faculty of Education, Lead City University, Ibadan, Oyo State is in full compliance

with the approved University format and style.

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Signature **Date**