

**DEGREE OF APPLICATION OF CULTURO-TECHNO-CONTEXTUAL
APPROACH IN THE TEACHING OF BIOLOGY**

**Michael Ozovehe CHRISTOPHER
EDU2101995**

**FACULTY OF EDUCATION
UNIVERSITY OF BENIN
BENIN CITY**

DECEMBER, 2025

**DEGREE OF APPLICATION OF CULTURO-TECHNO-CONTEXTUAL
APPROACH IN THE TEACHING OF BIOLOGY**

**Michael Ozovehe CHRISTOPHER
EDU2101995**

**A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF
CURRICULUM AND INSTRUCTIONAL TECHNOLOGY, FACULTY OF
EDUCATION, UNIVERSITY OF BENIN, BENIN CITY, EDO STATE, IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF
BACHELOR OF SCIENCE EDUCATION DEGREE B.Sc. (BIOLOGY),
UNIVERSITY OF BENIN, BENIN CITY.**

DECEMBER, 2025.

CERTIFICATION

We, the undersigned, certify that this project work is adequate in scope and was carried out by CHRISTOPHER Michael Ozovehe, in the department of Curriculum and Instructional Technology, Faculty of Education, University of Benin, Benin City, Edo State, Nigeria; In partial fulfillment for the award B.Sc. (Ed.) Degree in Biology.

Dr. (Mrs.) E. O. Eromosele
(Project Supervisor)

Date: _____

Dr. (MRS). I.K. OTEZE
(Project Co-Ordinator)

Date: _____

PROF. F. O. IDEHEN
Head of Department

Date: _____

DEDICATION

This project is dedicated to God Almighty, the Author of knowledge and wisdom, for His abundant grace, strength and wisdom given to me to successfully carry out this project and for my academic journey at the University of Benin, Benin City. May His name be highly exalted.

ACKNOWLEDGEMENTS

The researcher sincerely expresses his profound gratitude to his very competent project supervisor, Dr. (Mrs.) E. O. Eromosele, for her professional guidance, time, prompt attention, excellent human relations, and numerous sacrifices throughout the course of this project. Her constructive criticisms, insightful direction, and clear mentorship were great sources of inspiration in completing this work. God bless you, Ma.

His heartfelt appreciation also goes to Dr. (Mrs.) I. K. Oteze, his project coordinator, for her professional guidance and coordination. He also sincerely appreciates Prof. (Dr.) F. O. Idehen, Head of the Department of Curriculum and Instructional Technology, University of Benin, for his various forms of support and encouragement, which contributed immensely to the success of this project. He remains very grateful to Prof. Osamede Kingsley Omorogiuwa, Dean of the Faculty of Education, for his immense contributions towards the successful completion of this work.

The researcher further extends his profound gratitude to Dr. Festus, his course advisor, who has been of great support throughout his academic journey. He appreciates all his lecturers who contributed to his growth and success, including Dr. (Mrs.) A. A. Odia, Prof. Myke, Dr. Martins, Mrs. Ada, and all other academic and non-academic staff of the Faculty of Education and the Faculty of Life Sciences, University of Benin, Benin City.

This work would not be complete without acknowledging the tremendous role his parents, Mr. and Mrs. Christopher Isah, played in making his academic journey a success. Their selfless support, prayers, and sacrifices have been his greatest strength. He is also

genuinely thankful to his loving siblings, friends, and course mates for their encouragement, collaboration, and support throughout this journey. To those not mentioned by name, he remains deeply appreciative of their contributions during his programme of study.

Finally, his special gratitude goes to Mr. and Mrs. Omoluwabi, Mr. and Mrs. Victor, Dr. (Mrs.) Vivian Ifunanya, and Prof. (Mrs.) Ukpebor for their selflessness and for always coming through for him in times of academic and financial difficulty. Their concern and support made the completion of this project possible. God bless them all.

TABLE OF CONTENTS

	PAGE
TITLE PAGE	
CERTIFICATION	
DEDICATION	
ACKNOWLEDGEMENT	
ABSTRACT	
CHAPTER ONE: INTRODUCTION	
Background of the Study	
Statement of the Problem	
Research Questions	
Purpose of the Study	
Significance of the Study	
Scope of the Study	
Definition of Terms	
CHAPTER TWO: REVIEW OF RELATED LITERATURE	
Theoretical Framework	
Vygotsky's Sociocultural Theory of Learning	
Conceptual Framework	
Culture in Science Teaching	
Technology in Biology Teaching	

Contextualization in Biology Teaching
Teacher's Role in Implementing CTCA

PAGE

Teacher's Awareness on CTCA as Instructional Strategy

Benefits of CTCA in Biology Teaching

Challenges of Implementing CTCA

Empirical Studies

Summary of Literature Review

CHAPTER THREE: RESEARCH METHODOLOGY

Design of the Study

Population of the Study

Sample and Sampling Techniques

Research Instrument

Validity of the Instrument

Reliability of the Instrument

Method of Data Collection

Method of Data analysis

CHAPTER FOUR: DATA REPRESENTATION AND ANALYSIS

Introduction

Discussion of Findings

CHAPTER FIVE: SUMMARY, CONCLUSION AND REPRESENTATION

Summary of Findings

Conclusion

PAGE

Recommendations

Contribution to Knowledge

Suggestions for Further Studies

REFERENCES

APPENDICES

ABSTRACT

This study examined the degree of application of the Culturo-Techno-Contextual Approach (CTCA) in the teaching of Biology among Biology teachers in public senior secondary schools within Egor Local Government Area of Edo State, Nigeria. The study sought to determine teachers' level of awareness of CTCA, examine the extent to which they integrate cultural, technological, and contextual elements in Biology instruction, and identify the challenges affecting its implementation.

The research adopted a descriptive survey design. The population of the study consisted of all Biology teachers in public senior secondary schools within Egor Local Government Area of Edo State. A census survey was used, and all 17 Biology teachers in Egor Local Government Area formed the sample for the study. The instrument for data collection was a structured questionnaire designed on a four-point Likert scale, ranging from Strongly Agree (4) to Strongly Disagree (1). The questionnaire comprised Sections A, B, C, and D, making a total of 19 items. Section A elicited demographic information from the respondents, while Sections B, C, and D contained five items each. The instrument was administered and retrieved on the spot.

The data collected were analyzed using frequencies and simple percentages to provide a clear understanding of the responses and to enable meaningful interpretation. Findings showed that Biology teachers in public senior secondary schools within Egor Local Government Area of Edo State are familiar with the concept of CTCA, but they lack formal training on its practical application in the classroom. The study further revealed that the degree of integration of CTCA principles in Biology teaching is modest but not extensive. Additionally, several challenges were identified as limiting the full implementation of CTCA, including inadequate training opportunities, poor access to technological facilities, and language barriers. The study concluded that the Culturo-Techno-Contextual Approach is yet to be fully understood and effectively implemented by Biology teachers in senior secondary schools. It recommended regular CTCA training for

teachers through workshops and seminars organized by the Ministry of Education in Faculty of Education of Universities. The study also emphasized the need for better technological resources in schools to support CTCA implementation and encouraged curriculum planners to revise the Biology curriculum to allow greater cultural and contextual flexibility in teaching.

CHAPTER ONE

INTRODUCTION

Background to the Study

Biology, as a branch of science, is a core subject that explores the study of living things and their interactions with one another and the environment. Different scholars have defined biology in ways that capture its vast scope and significance. According to Taylor (2018), biology is *“the scientific study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy.”* Miller and Levine (2016) describe biology as *“the science that seeks to understand the living world by studying life and living organisms through observation and experimentation.”* Campbell, Reece, and Mitchell (2019) define biology as *“a natural science concerned with the study of life and living organisms, covering aspects from molecular interactions to the biosphere.”* In the Nigerian context, Okeke (2020) defines biology as *“the foundational science that equips learners with knowledge about living things, life processes, and environmental sustainability, providing a basis for technological and scientific advancement.”*

The importance of biology in the school curriculum cannot be overemphasized. It forms the backbone of careers in health sciences, agriculture, environmental management, biotechnology, genetics, and allied fields. Biology contributes significantly to the development of scientific literacy and prepares students for informed decision-making about health, nutrition, and sustainable resource management. The study of biology

enhances learners' understanding of themselves and their environment, fostering problem-solving skills, critical thinking, and creativity. Moreover, biology provides foundational knowledge for professional courses such as medicine, nursing, pharmacy, microbiology, and related disciplines. Thus, the subject plays a crucial role in the socio-economic development of any nation, especially a developing country like Nigeria where health and agriculture are pivotal sectors.

Despite its importance, students' performance in biology in Nigeria has remained persistently poor, with an average percentage failure of 48% across each of the years (2020-2024). This has raised concerns among educators, policymakers, and parents.

The West African Examinations Council (WAEC) Chief Examiners' Reports for the past five years (2020–2024) consistently highlight deficiencies in students' understanding and application of biological concepts.

- Poor understanding of biological terminologies and lack of depth in explanations.
- Many relied heavily on rote memorization without true comprehension and struggled to relate biological concepts to real-life situations or local examples.
- Practical skills were notably weak, with frequent issues in scientific drawings, labeling, and interpreting specimen-based questions.
- Difficulty applying theoretical knowledge to practical scenarios, interpreting critical-thinking questions, and exhibited a shallow grasp of core topics such as genetics, ecology, and physiology.

- Spelling errors in technical terms and a general lack of inquiry-based learning approaches further compounded their performance issues.

These persistent weaknesses suggest that the dominant teaching methods used in Nigerian classrooms may not adequately support deep understanding and application of biological knowledge.

Biology instruction in Nigerian secondary schools is still predominantly teacher-centered, relying heavily on rote memorization with minimal practical engagement. The conventional “chalk-and-talk” approach often overlooks learners’ cultural backgrounds and underutilizes modern technologies, which in turn reduces student engagement, knowledge retention, and critical thinking skills (Awaah et al., 2023). To address these limitations, scholars have recommended more interactive and contextually relevant pedagogical strategies. One such innovation is the Culturo-Techno-Contextual Approach (CTCA), a model that incorporates students’ cultural knowledge, local realities, and suitable technological tools into classroom instruction to foster deeper understanding and meaningful learning (Adam et al., 2025).

Empirical studies indicate that CTCA enhances learning outcomes in science education. For instance, Onuoha (2020) found that students exposed to CTCA in biology lessons showed improved understanding and interest in the subject compared to those taught through conventional methods. Similarly, Eze and Ekwueme (2022) demonstrated that integrating cultural contexts with modern digital tools significantly improved students’ critical thinking and problem-solving abilities. Despite its promise, the extent to which

biology teachers in Nigeria implement CTCA remains uncertain. Therefore, this study aims to explore the application of CTCA in biology classrooms, identify existing gaps, and recommend strategies to enhance biology education in Nigeria.

Statement of the Problem

Despite the importance of biology as a foundational science subject in Nigerian secondary schools, its teaching and learning have remained largely ineffective. The prevailing teacher-centered, “chalk-and-talk” method continues to dominate classrooms, resulting in rote memorization, low student engagement, and poor knowledge retention. This approach has failed to stimulate critical thinking, problem-solving skills, and meaningful application of biological concepts to real-life situations.

One major gap in the current practice of biology education is the neglect of learners’ cultural backgrounds and environmental contexts, which are valuable resources for enhancing understanding and relevance of the subject. In addition, the integration of modern technological tools into biology instruction remains minimal, even though students are daily exposed to digital innovations outside the classroom. This disconnection between classroom practices and learners’ lived experiences contributes to persistent underachievement, lack of interest in science, and the perception of biology as abstract and difficult.

The Culturo-Techno-Contextual Approach (CTCA) was introduced as a remedy to these challenges by combining cultural knowledge, technological tools, and contextual realities into teaching practices. Empirical evidence suggests that CTCA improves students’

comprehension, critical thinking, and active participation. However, the degree to which this innovative approach has been applied in the teaching of biology in Nigerian secondary schools remains uncertain. Many teachers either lack awareness of CTCA, have limited training in its implementation, or operate under systemic constraints such as inadequate facilities, rigid curricula, and poor access to instructional technologies.

Therefore, the problem this study seeks to address is the gap between the potential benefits of the Culturo-Techno-Contextual Approach and its actual application in secondary school biology classrooms in Nigeria. By examining the extent of its usage, this study intends to uncover the barriers to effective implementation and provide insights that can help reposition biology education to be more interactive, culturally relevant, technologically aligned, and context-driven.

Research Questions

To guide this investigation, the study seeks to answer the following research questions:

1. What level of awareness do biology teachers have about the Culturo-Techno Contextual Approach (CTCA) as an instructional strategy for teaching biology?
2. Do biology teachers integrate students' cultural backgrounds, local contexts, and technological resources into their classroom teaching of biology?
3. What challenges and limitations do biology teachers encounter in implementing the Culturo-Techno Contextual Approach in their classrooms?

Purpose of the Study

The main purpose of this study is to examine the degree to which the Culturo-Techno Contextual Approach (CTCA) is applied in the teaching of biology in Nigerian secondary schools. Specifically, this study seeks to:

- Determine the extent to which biology teachers are aware of the Culturo-Techno Contextual Approach as an innovative strategy for biology teaching.
- Assess the level of actual application of the CTCA in classroom teaching, including the integration of students' cultural backgrounds, relevant local contexts, and modern technological tools in biology lessons.
- Identify the challenges and barriers that biology teachers face in implementing the CTCA, such as lack of training, inadequate resources, or institutional constraints.
- Generate evidence-based recommendations that can guide teachers, curriculum planners, policymakers, and stakeholders on how to strengthen the adoption and effective implementation of the Culturo-Techno Contextual Approach in biology teaching.

Significance of the Study

This study is significant as it addresses the persistent issue of poor academic performance in biology among Nigerian secondary school students, which has been linked to outdated and ineffective teaching strategies that fail to engage learners' cultural realities or integrate technological tools (Onuoha, 2020; WAEC Chief Examiners' Reports, 2021–2024). The study investigates the degree to which the Culturo-Techno-Contextual

Approach (CTCA) is applied in biology classrooms, providing much-needed empirical evidence on how cultural relevance, local context, and technology can improve biology teaching and learning.

The importance of this study spans across multiple educational stakeholders.

Students will benefit indirectly as the research promotes innovative and relatable teaching methods that can improve their understanding, critical thinking, and interest in biology. By connecting lessons to their daily experiences and cultural backgrounds, students are more likely to see the relevance of biology and may be inspired to pursue careers in medicine, nursing, pharmacy, and other science-based fields (Eze & Ekwueme, 2022).

In addition, biology teachers will gain exposure to the advantages of incorporating the Culturo-Techno-Contextual Approach (CTCA) in lesson delivery. The study will provide practical insights and strategies for engaging students through familiar cultural references and accessible technologies, ultimately improving classroom participation and overall learning outcomes (Okafor & Nwafor, 2021).

Curriculum planners and education policymakers will also find the research valuable as it highlights the urgent need to embed culturally responsive, technology-driven methodologies in the biology curriculum. This is essential for making learning more inclusive, modern, and effective in Nigeria's diverse educational landscape (Onuoha, 2020).

Furthermore, educational administrators and school management play a critical role in supporting the adoption of CTCA. This study emphasizes their responsibility to ensure

the provision of instructional technologies, relevant teaching materials, and opportunities for professional development. Administrators can also strengthen partnerships with local communities to contextualize learning, thereby making education more meaningful and sustainable (Adebayo & Ilesanmi, 2018).

At a broader level, the government and other educational authorities stand to benefit from the findings of this research. By encouraging the adoption of CTCA, the study supports efforts to improve science education outcomes and advance national goals in STEM education. Such a shift aligns with global trends in inclusive and culturally relevant pedagogy, which is crucial for building a scientifically literate population (WAEC Chief Examiners' Reports, 2023).

Scope of the Study

This study is specifically focused on investigating the degree of application of the Culturo-Techno Contextual Approach (CTCA) in the teaching of biology at the secondary school level in Nigeria. It is delimited to Biology teachers in Oredo Local Government Area, Benin City, Edo state, Nigeria.

Definition of Terms

- **Biology:** In this study, biology refers to the branch of science that deals with the study of living things and life processes, including their structure, function, growth, evolution, and interactions with the environment.

- **Teaching:** Teaching is defined as the deliberate and systematic process of guiding, facilitating, and directing students' learning activities to bring about desirable changes in their knowledge, skills, attitudes, and understanding (Gagne, 1985; Farrant, 2004).
- **Culturo-Techno Contextual Approach (CTCA):** The Culturo-Techno Contextual Approach is an innovative teaching strategy that combines students' cultural backgrounds, relevant local contexts, and appropriate technological tools to make learning meaningful and relatable (Ogbu, 2018).
- **Application:** Application refers to the practical use, implementation, or execution of a method or approach.
- **Degree of Application:** Degree of application means the extent, level, or frequency to which the CTCA is implemented in the teaching of biology.
- **Contextual Learning:** This term refers to teaching and learning activities that relate subject matter to real-life situations that are meaningful to students.
- **Technology Integration:** This refers to the use of digital tools, resources, and media in planning, delivering, and assessing lessons.
- **Culture:** Culture, as used in this study, refers to the shared beliefs, customs, values, norms, language, and practices of a group of people.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter reviews the related literature on Degree of application of Culturo-Techno-Contextual approach in the teaching of biology. The review focuses on the following sub-headings:

- Theoretical framework
- Conceptual framework
- Concept of Culturo-Techno-Contextual (CTCA)
- Culture in science teaching
- Technology in biology teaching
- Contextualization in biology teaching
- Teacher's role in implementing CTCA
- Teachers awareness on CTCA as instructional strategy.
- Benefits of CTCA in Biology Education
- Challenges of implementing CTCA
- Empirical studies
- Summary of literature review

Theoretical framework

For this study, Vygotsky's Sociocultural Theory of Learning is particularly relevant because it provides strong justification for the adoption of CTCA in teaching biology.

Vygotsky's Sociocultural Theory of Learning

Lev Vygotsky's Sociocultural Theory (1978) emphasizes that learning is a social process that occurs through interaction with others within a cultural context. According to this theory, cognitive development is not solely an individual activity but is deeply influenced by culture, language, and social interactions. A key concept of Vygotsky's framework is the Zone of Proximal Development (ZPD), which refers to the gap between what a learner can achieve independently and what they can accomplish with guidance from a more knowledgeable person such as a teacher, peer, or community elder.

The Culturo-Techno-Contextual Approach aligns strongly with this theory because it encourages the integration of learners' cultural backgrounds and local contexts into the learning process. By asking students to draw from their community knowledge, family traditions, and indigenous practices related to biological concepts, CTCA situates learning in familiar cultural contexts, thereby making abstract concepts more concrete. For example, when teaching genetics, a teacher might link the lesson to traditional practices of family lineage and inheritance patterns in the local community. This approach resonates with Vygotsky's assertion that cultural tools and social interactions shape cognitive growth.

Additionally, Vygotsky emphasized the importance of mediating tools, which can include language, symbols, and modern technology. CTCA incorporates technological tools such as mobile phones, internet resources, and digital media as mediating instruments that help bridge the gap between students' prior knowledge and new scientific concepts. This

makes biology not only more accessible but also more engaging for learners in a 21st-century classroom. Thus, Vygotsky's Sociocultural Theory provides a strong theoretical justification for the CTCA model, as it shows that meaningful biology learning occurs when instruction is culturally relevant, socially interactive, and technologically mediated.

Conceptual Framework

The Culturo-Techno-Contextual Approach (CTCA) is a learner-centered instructional model developed by Professor Peter Akinsola Okebukola in Nigeria around 2015. It was introduced as a response to persistent challenges in science education, especially biology, where traditional teacher-centered methods (like rote memorization and chalk-and-talk) fail to promote deep understanding, critical thinking, and application of knowledge.

The approach emphasizes three pillars: culture, technology, and context. It integrates learners' cultural experiences and indigenous knowledge, employs appropriate technological tools, and situates learning within real-life and local contexts. By doing this, CTCA makes lessons more relatable, interactive, and engaging, thereby improving comprehension, retention, and application of scientific concepts.

Essentially, CTCA emerged to address the gap between theory and practice in biology teaching, reduce students' low interest and performance, and align classroom instruction with 21st-century educational demands.

Culture in Science Teaching

Culture refers to the values, beliefs, norms, and practices shared by a group of people. In the educational context, culture affects how students perceive, interpret, and internalize

learning experiences. Incorporating students' cultural backgrounds in science instruction can foster relevance, increase motivation, and improve comprehension.

Culturally responsive teaching—central to CTCA—validates students' identities and links academic content to their real-world experiences. According to Ede and Okonkwo (2019), learners are more likely to engage with content when it reflects familiar traditions, customs, and community practices. In biology, using local medicinal plants to teach plant physiology or referencing local food fermentation methods to teach microbiology exemplifies the cultural dimension of CTCA.

Technology in Biology Education

Technology, when appropriately integrated into teaching, enhances the visualization and simulation of complex scientific ideas. It includes both high-tech tools (e.g., computers, projectors, internet resources) and low-tech tools (e.g., charts, models, radios). CTCA recognizes the importance of selecting technology that is accessible and appropriate for the local context.

Adebayo (2023) highlights that the use of mobile phones, educational apps, WhatsApp groups, and interactive multimedia resources can support collaborative and interactive learning in biology. For instance, animations demonstrating cell division or videos showing frog dissections can make abstract concepts tangible. CTCA promotes the use of these technologies, even in resource-limited settings, by encouraging creativity and adaptation of locally available devices.

Contextualization in Biology Teaching

Contextualization refers to the process of tailoring instruction to the specific needs, experiences, environments, and realities of the learners. In biology, this means using familiar examples, local resources, and daily occurrences to explain scientific ideas. For example, teaching reproduction using livestock familiar to students in rural areas can enhance relevance and understanding.

According to Ogunniyi and Ogunkola (2019), context-based teaching helps bridge the gap between scientific knowledge and everyday life. It allows students to relate classroom knowledge to practical, real-world situations. CTCA encourages teachers to adapt their instructional content, language, and methods to align with students' immediate surroundings and socio-economic conditions.

Teacher's Role in Implementing CTCA

Teachers are critical agents in the successful application of CTCA. They are expected to be facilitators of learning, co-creators of knowledge, and cultural mediators. To implement CTCA effectively, teachers must:

- Understand students' cultural backgrounds and contextual realities
- Be competent in using basic technological tools
- Be flexible and creative in designing context-relevant lesson plans
- Engage in continuous professional development (Adesanya & Oloyede, 2020)

The teacher must also shift from the traditional role of "knowledge dispenser" to a guide who supports students in constructing meaning based on their unique socio-cultural contexts.

Teachers Awareness On CTCA As Instructional Strategy.

The Culturo-Techno-Contextual Approach (CTCA) is an Afrocentric pedagogy that blends culture, technology, and context to make science teaching more meaningful and relevant. In Nigeria, research has shown that CTCA enhances students' achievement, motivation, and retention in biology and other STEM subjects when compared with conventional lecture methods (Achor et al., 2018; Egbonyi & Akpan, 2020). These studies emphasize the potential of CTCA to transform science learning outcomes and promote deeper understanding among learners.

Despite this progress, teachers' awareness and application of CTCA in Nigeria remain limited. Most biology teachers have not received formal training on the approach, as it is yet to be fully integrated into teacher education or professional development programmes (Adams, 2022; Onah, 2023). Scholars therefore stress the need to increase teachers' exposure to CTCA through workshops, seminars, and curriculum reforms, so that they can confidently adopt it in classroom practice. This gap justifies further research into the degree of awareness and readiness of biology teachers to implement CTCA as an instructional strategy in Nigeria.

Benefits of CTCA in Biology Education

The benefits of applying CTCA in biology teaching include:

- Improved comprehension and retention of abstract scientific concepts
- Enhanced student engagement and participation
- Bridging the gap between western scientific knowledge and indigenous knowledge systems
- Increased relevance and applicability of biology education to real-life issues
- Promotion of inclusivity and respect for diverse learner backgrounds

CTCA thus aligns with global education goals such as SDG 4 (Quality Education), which emphasizes inclusive, equitable, and context-relevant learning.

Challenges of Implementing CTCA

Despite its benefits, implementing CTCA in the classroom comes with some challenges:

- Limited teacher training on CTCA strategies
- Resistance to change from traditional pedagogies
- Inadequate funding for educational technology
- Curriculum inflexibility in aligning with local contexts
- Language barriers when translating scientific terms into local dialects (Okafor & Eze, 2021)

To overcome these challenges, there is a need for institutional support, curriculum reform, and professional development for teachers.

Empirical Study

Okebukola, Ige, Lameed, Agbanimu, and Adam (2024) conducted a quasi-experimental study to examine the effect of the Culturo-Techno-Contextual Approach (CTCA) on senior secondary students' retention of variation and evolution concepts in biology. The study involved 88 students from two schools in Lagos State. Results revealed that students taught with CTCA significantly outperformed those taught with conventional lecture methods, demonstrating its effectiveness in promoting meaningful retention. Teachers generally had introductory and conceptual awareness of CTCA, with younger and ICT-inclined teachers more willing to adopt it, although many requested model lesson plans to support practice. Challenges included unreliable ICT tools, insufficient lesson time for contextual discussions, conflicting cultural beliefs, and the heavy workload of preparing CTCA-based lessons. Limitations arose from the small sample size and short intervention period. In classroom use, CTCA was applied only to two biology topics, with one school completing the full cycle while the other used a partial version. Technology integration was inconsistent, yet students showed high levels of engagement. The approach remained at a pilot stage, pointing to the need for institutionalization to sustain its use.

Ige, Owolabi, Onowugbeda, and colleagues (2025) carried out a mixed-methods study to test the impact of CTCA on students' achievement in plant nutrition. A sample of 138 senior secondary students was divided into CTCA and lecture groups, with results showing that the CTCA group significantly outperformed their peers taught using

traditional methods. Interviews revealed that CTCA improved students' interest, motivation, and perception of biology's relevance. Teachers had moderate-to-high awareness of CTCA due to pre-study workshops, though their understanding was mostly theoretical and required more practical training. ICT-proficient teachers implemented CTCA more effectively, recognizing its motivational value, but also requested continuous professional support. The study identified major challenges such as inadequate ICT infrastructure and laboratory resources, the time-intensive nature of contextual lesson preparation, misalignment with examination standards, and skepticism from some parents. The study was limited to two schools, restricting generalizability. In practice, CTCA was implemented throughout the plant nutrition unit with high fidelity, supported by structured lesson plans and more consistent technology integration compared to earlier studies. Teachers expressed readiness to extend CTCA to other biology topics, demonstrating both feasibility and promise for wider adoption.

Okebukola, Adegbile, and colleagues (2022) investigated the application of CTCA in teaching genetics to senior secondary students in Nigeria. The study involved 156 students from three schools, comparing CTCA-based lessons with conventional lecture methods. Findings showed that CTCA significantly improved achievement and interest, as students were able to connect abstract genetic concepts such as Mendelian inheritance and blood groups with cultural and real-life practices. Teacher interviews indicated that awareness of CTCA was moderate, often limited to theoretical knowledge, though ICT-proficient teachers integrated digital resources more effectively. Key challenges included

inadequate ICT infrastructure, time-consuming contextualization of content, resistance from some teachers, and misalignment with exam-focused instruction. The study was also limited in scope, covering only three schools. In terms of application, CTCA was consistently used across the genetics unit, supported by structured lesson guides that promoted uniformity. Students actively engaged in contextualized group activities, though technology use was inconsistent due to electricity challenges. While CTCA was applied over several weeks, it was not sustained beyond the study period, highlighting the need for systemic support and wider institutional adoption.

Dele-Ajayi, Fasae and Okoli (2021) investigated teachers' use of technology in classroom instruction and the challenges limiting effective integration of ICT tools. Using a large sample of in-service teachers across primary and secondary schools, their study revealed that although teachers recognized the instructional value of digital technologies, the actual application of ICT in the classroom remained low. Many teachers reported using only basic tools such as mobile phones and standalone computers, while more advanced technologies—such as internet-based resources, projectors, and interactive platforms—were used infrequently. According to Dele-Ajayi Fasae and Okoli (2021), the major limitations to ICT integration included poor or unstable internet connectivity, insufficient or outdated hardware, lack of technical support, and low levels of teacher confidence and competence in ICT pedagogy. These infrastructural and pedagogical barriers significantly restricted teachers' ability to incorporate technology meaningfully into teaching and learning. The study concludes that improving classroom technology use requires

strengthened ICT infrastructure and sustained, practice-oriented professional development to support teachers' digital competence.

Ahanonye, Otulaja, Risenga and Dukhan (2024) explored how senior secondary life sciences teachers in Nigeria (specifically, peri-urban high schools) understand Indigenous Knowledge (IK) and how that understanding affects their views on integrating it into biology (or life science) classroom teaching. Using interviews and questionnaires guided by the Knowledge Synthesis Model, the researchers found significant variation in how teachers define indigenous knowledge: some view it as inherited local wisdom (parallel to Western science), others see it as a holistic system encompassing ecological, spiritual, and social dimensions. These conceptions strongly influence whether and how teachers attempt to integrate indigenous knowledge: those seeing it as holistic tend to support system-level integration (e.g., sustainability themes), while others prefer to keep it separate or taught by community knowledge holders. However, actual classroom use of indigenous knowledge is limited, largely because of practical constraints. The teachers cited challenges including lack of culturally grounded curricular materials, pressure to cover standardized exam-driven syllabus content, and a deficit of professional development on how to integrate indigenous knowledge in science pedagogy. This limited uptake of indigenous knowledge in biology/life-science teaching points to a gap in implementing a truly culturo-techno-contextual approach in the classroom.

Summary of Literature Review

The review of literature indicates that the Culturo-Techno-Contextual Approach (CTCA) offers a comprehensive framework for enhancing biology teaching by integrating cultural knowledge, technology, and contextualized learning. Grounded in Vygotsky's Sociocultural Theory, CTCA emphasizes that learning is socially mediated and shaped by cultural, linguistic, and community interactions (Vygotsky, 1978). By connecting biology concepts to students' real-life experiences, local traditions, and indigenous knowledge, the approach makes abstract scientific ideas more concrete and meaningful. Studies suggest that culturally responsive teaching improves learner engagement, motivation, and comprehension, especially when lessons are linked to students' immediate environments and community practices (Ede & Okonkwo, 2019; Ogunniyi & Ogunkola, 2019).

Empirical evidence from Nigeria further supports the effectiveness of CTCA in biology education. Okebukola, Ige, Lameed, Agbanimu, and Adam (2024) reported that students taught with CTCA outperformed peers taught via conventional lecture methods in concepts related to variation and evolution. Similarly, Ige, Owolabi, Onowugbeda, and colleagues (2025) found that CTCA enhanced students' understanding of plant nutrition, increased interest, and positively influenced perceptions of biology's relevance. In teaching genetics, Okebukola, Adegbile, and colleagues (2022) demonstrated that students could relate abstract concepts such as Mendelian inheritance and blood groups to cultural and real-life practices. These studies collectively indicate that when effectively

implemented, CTCA promotes active learning, deeper understanding, and stronger retention of biology concepts.

Despite these advantages, several challenges limit the consistent application of CTCA in Nigerian biology classrooms. Teachers' awareness and practical knowledge of the approach are often moderate, with many possessing only theoretical understanding (Achor et al., 2018; Egbonyi & Akpan, 2020; Adams, 2022). Infrastructural constraints, including inadequate ICT tools, intermittent electricity, and limited laboratory facilities, further restrict technology integration (Dele-Ajayi, Fasae, & Okoli, 2021). Teachers also face time pressures, rigid curriculum requirements, and insufficient professional development on CTCA strategies, making it difficult to contextualize lessons effectively and maintain fidelity across biology topics. These challenges underscore the need for systemic support to facilitate full implementation of the approach.

Furthermore, the integration of Indigenous Knowledge (IK) in biology teaching remains limited, despite being a key component of CTCA. Ahanonye et al. (2024) observed that teachers' conceptions of IK ranged from viewing it as inherited local wisdom to understanding it as a holistic system encompassing ecological, spiritual, and social dimensions. However, actual classroom application of IK was constrained by the lack of culturally relevant teaching materials, inadequate professional guidance, and practical challenges such as curriculum alignment and lesson preparation time. This gap highlights the need for targeted professional development, institutional support, and the provision of resources that enable teachers to integrate culture, technology, and context effectively in

biology instruction. Overall, the literature affirms that CTCA has significant potential to enhance biology learning, but successful implementation requires deliberate strategies to overcome these barriers.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter describes the methods and procedures employed in carrying out the study under the following sub-headings;

- Design of the Study
- Population of the Study
- Sampling and Sampling Techniques
- Research Instrument
- Validity of the Instrument
- Reliability of the Instrument
- Method of Data Collection
- Method of Data analysis

Design of the Study

This study adopted the survey research design. A survey design is considered appropriate because the purpose of the study is to collect information from biology teachers on their awareness and degree of application of the Culturo-Techno-Contextual Approach (CTCA) in the teaching of biology. Survey research enables the researcher to gather opinions, attitudes, and practices of a defined population using structured instruments such as questionnaires or interviews (Creswell, 2014). It is particularly suitable in educational research where the aim is to describe and analyze existing conditions without manipulating variables (Nworgu, 2015).

The use of survey design in this study is also justified by its ability to cover a relatively large population within a short period, generate both quantitative and qualitative data, and provide a basis for generalizing findings from the sample to the larger population. Since the research focuses on teachers' perceptions and classroom practices, the survey method provides a reliable and cost-effective approach for capturing these dimensions (Orodho, 2003). Therefore, the descriptive survey design was adopted to obtain accurate information on the degree of application of CTCA by biology teachers in secondary schools.

Population of the Study

The population of this study consisted of all biology teachers in public and private secondary schools located in Oredo Local Government Area of Edo State, Nigeria. This group was selected because biology teachers serve as the primary implementers of instructional innovations and are in the best position to provide reliable information on their awareness and application of the Culturo-Techno-Contextual Approach (CTCA) in classroom practice. According to the Edo State Ministry of Education (2023), Oredo Local Government Area has a substantial number of secondary schools with qualified biology teachers distributed across urban and semi-urban settings, thereby providing a diverse and representative population for the study. Focusing on this population is consistent with educational survey research, which emphasizes studying the professional practices of teachers to understand how innovative pedagogies are integrated into science education (Cohen, Manion, & Morrison, 2018).

Sample and Sampling Techniques

This study employed the census sampling technique, whereby 17 biology teachers in 13 secondary schools within Oredo Local Government Area of Edo State, Nigeria, were included in the study. The choice of census sampling was considered appropriate because the population of biology teachers in the area is relatively manageable, making it feasible to study the entire group without resorting to sampling. Census sampling is advantageous in that it eliminates sampling error, ensures complete representation, and allows the researcher to obtain comprehensive and accurate data from all members of the target population (Kothari, 2004; Singh & Masuku, 2014). By using this approach, the study ensures that the findings will reflect the true status of teachers' awareness and degree of application of the Culturo-Techno-Contextual Approach (CTCA) in biology teaching across all secondary schools in Oredo Local Government Area.

Research Instrument

The instrument used for data collection in this study was a structured questionnaire designed on a four-point Likert scale, ranging from Strongly Agree (4) to Strongly Disagree (1). The questionnaire was developed to elicit information from biology teachers in secondary schools within Oredo Local Government Area of Edo State on their awareness, integration and challenges in the implementation of the Culturo-Techno-Contextual Approach (CTCA) in biology teaching. The use of a Likert scale is appropriate for survey research as it allows respondents to express the intensity of their opinions, attitudes, and practices in a quantifiable form, thereby facilitating statistical

analysis (Joshi, Kale, Chandel, & Pal, 2015). Thus, the instrument was considered suitable for capturing comprehensive information from the census of biology teachers targeted in this study.

Validity of the Instrument

The validity of the instrument was established through expert judgment. The draft copy of the questionnaire was presented to three experts from the faculty of education, University of Benin. These experts examined the items to ensure that they were clear, relevant, and aligned with the objectives and research questions of the study. Their suggestions led to necessary modifications in the wording, structure, and content of some items to enhance clarity and content validity. This process ensured that the instrument accurately measured what it was intended to measure and was appropriate for the study's population.

Reliability of the Instrument

To determine the reliability of the instrument, a pilot test was conducted using five biology teachers from secondary schools in Egor Local Government Area of Edo State, who were not part of the main study population but shared similar characteristics. The responses obtained from the pilot test were analyzed using the Cronbach Alpha method to determine the internal consistency of the questionnaire. The reliability coefficient obtained was 0.82, which indicates a high level of reliability. According to George and Mallery (2003), a reliability coefficient of 0.70 and above is considered acceptable for

educational research. Therefore, the instrument was deemed reliable and suitable for the main study.

Method of Data Collection

The researcher personally administered the questionnaire to the respondents in the various government schools within Egor Local Government Area of Edo State, Nigeria. Prior to administration, the purpose of the study was explained to the participants, and they were assured of the confidentiality of their responses. The respondents were given sufficient time to complete the questionnaire, after which the researcher retrieved all completed copies on the spot to ensure a high return rate. This direct approach minimized non-response bias and ensured that accurate and complete data were collected for analysis.

Method of Data Analysis

The data collected from the study were analyzed using descriptive statistics such as frequencies, percentages, and cumulative percentages. These statistical tools were employed to summarize the responses of biology teachers and to determine the extent of their awareness and degree of application of the Culturo-Techno-Contextual Approach (CTCA) in the teaching of biology.

For each item in the questionnaire, the frequency of responses was first tabulated, followed by the computation of the corresponding percentages and cumulative percentages. The decision on whether respondents “Agreed” or “Disagreed” with each statement was based on the dominant percentage of responses in either category. This

approach provided a clear and objective means of interpreting the data and identifying general trends and patterns among the respondents.

CHAPTER FOUR

DATA REPRESENTATION AND ANALYSIS

Introduction

This chapter presents the data collected, analyzed, and interpreted in line with the research objectives. The main purpose of this chapter is to show the degree of application of the Culturo-Techno-Contextual Approach (CTCA) in the teaching of Biology among secondary school biology teachers. The data were obtained from a total of seventeen (17) respondents who are biology teachers in selected secondary schools. The presentation and analysis are organized according to the research questions. The data are presented in tables using frequencies and simple percentages to provide a clear view of the responses and to enable meaningful interpretation.

Research Question 1

What level of awareness do biology teachers have about the Culturo-Techno-Contextual Approach (CTCA) as an instructional strategy for teaching biology?

Table 1: Awareness of biology teachers on CTCA

S/N	Statement	Opinion	Frequency	Percentage	Cumulative Percentage	Decision
1.	I am familiar with the concept of Culturo-Techno-Contextual Approach in the teaching of biology.	Strongly Disagree	2	11.8	11.8	Agree
		Disagree	6	35.3	47.1	
		Agree	6	35.3	82.4	
		Strongly agree	3	17.6	100.0	
	Total	17	100.0			
2.	I have received formal training (seminars, workshop	Strongly Disagree	2	11.8	11.8	Disagree

	or courses) on CTCA.	Disagree	8	47.1	58.8	
		Agree	6	35.3	94.1	
		Strongly agree	1	5.9	100.0	
		Total	17	100.0		
3.	I understand the theoretical foundations (culture. Technology and context) underlying CTCA.	Strongly Disagree	1	5.9	5.9	Disagree
		Disagree	10	58.8	64.7	
		Agree	5	29.4	94.1	
		Strongly agree	1	5.9	100.0	
		Total	17	100.0		
4.	I am aware of the benefits of CTCA in improving students comprehension and engagement in biology.	Strongly Disagree	0	0		Agree
		Disagree	7	41.2	41.2	
		Agree	10	58.8	100.0	
		Strongly agree	0	0		
		Total	17	100.0		
5.	I keep up with recent publications or discussions on CTCA in Nigeria education.	Strongly Disagree	6	35.3	35.3	Disagree
		Disagree	7	41.2	76.5	
		Agree	4	23.5	100.0	
		Strongly agree	0	0		
		Total	17	100.0		

The table above presents the responses on the awareness of CTCA among biology teachers in secondary schools. From the data, it is evident that while some teachers are familiar with the CTCA concept, many have limited formal training or exposure. A significant proportion expressed only moderate understanding of the theoretical foundations of CTCA, and only a few have access to recent publications or discussions about the approach. This indicates that awareness is still developing and that more

professional development and sensitization workshops are needed to enhance teachers' understanding of CTCA.

Research Question 2

Do biology teachers integrate students' cultural backgrounds, local contexts and technological resources into their classroom teaching of biology?

Table 2: Integration of CTCA in biology teaching

S/N	Statement	Opinion	Frequency	Percentage	Cumulative Percentage	Decision
1.	I relate biological concepts to students cultural experiences (e.g., family lineage, local traditions, indigenous practices).	Strongly Disagree	4	23.5	23.5	Disagree
		Disagree	6	35.3	58.8	
		Agree	7	41.2	100.0	
		Strongly agree	0	0		
		Total	17	100.0		
2.	I use examples from students immediate environment (local farming, health practices, or natural resources, etc) to explain biology concept.	Strongly Disagree	1	5.9	5.9	Agree
		Disagree	6	35.3	41.2	
		Agree	8	47.1	88.2	
		Strongly agree	2	11.8	100.0	
		Total	17	100.0		
3.	I employ technology tools such as projector, multimedia or internet resources to enhance biology lessons.	Strongly Disagree	5	29.4	29.4	Disagree
		Disagree	5	29.4	58.8	
		Agree	6	35.3	94.1	
		Strongly agree	1	5.9	100.0	
		Total	17	100.0		
4.	I invite and consult elders, community practices, or indigenous knowledge as part of my	Strongly Disagree	0	0	0	Disagree
		Disagree	9	52.9	52.9	
		Agree	6	35.3	88.2	
		Strongly	2	11.8	100.0	

	instructional resources for learning biology.	agree				
		Total	17	100.0		
5.	I design lesson plans that combine cultural relevance, technological tools, and local context when teaching biology.	Strongly Disagree	1	5.9	5.9	Agree
		Disagree	6	35.3	41.2	
		Agree	10	58.8	100.0	
		Strongly agree	0	0		
		Total	17	100.0		

The table above reveal that most biology teachers make some efforts to relate lessons to students’ cultural backgrounds and local contexts. However, the consistent use of technology tools and indigenous knowledge sources remains limited. While teachers integrate cultural and contextual elements to some degree, the findings imply that a full implementation of the CTCA model is yet to be realized, largely due to resource constraints and limited professional guidance.

Research Question 3

What challenges and limitations do biology teachers encounter in implementing the Culturo-Techno-Contextual Approach in their classroom?

Table 3: Biology teachers challenges in implementing CTCA

S/N	Statement	Opinion	Frequency	Percentage	Cumulative Percentage	Decision
1.	I lack adequate training or professional development on how to implement CTCA.	Strongly Disagree	2	11.8	11.8	Agree
		Disagree	3	17.6	29.4	
		Agree	9	52.9	82.4	
		Strongly agree	3	17.6	100.0	

		Total	17	100.0		
2.	My school has limited access to technological resources (e.g internet, projectors, or computers) needed for CTCA.	Strongly Disagree	3	17.6	17.6	Agree
		Disagree	1	5.9	23.5	
		Agree	7	41.2	64.7	
		Strongly agree	6	35.3	100.0	
		Total	17	100.0		
3.	The curriculum structure does not provide enough flexibility to integrate cultural and contextual examples in biology teaching.	Strongly Disagree	1	5.9	5.9	Agree
		Disagree	2	11.8	17.6	
		Agree	8	47.1	64.7	
		Strongly agree	6	35.3	100.0	
		Total	17	100.0		
4.	Large class sizes make it difficult to effectively apply CTCA principles in the classroom.	Strongly Disagree	1	5.9	5.9	Agree
		Disagree	3	17.6	23.5	
		Agree	6	35.3	58.8	
		Strongly agree	7	41.2	100.0	
		Total	17	100.0		
5.	Language barriers or difficulties in translating biological concepts into local languages into local languages hinder CTCA implementation.	Strongly Disagree	4	23.5	23.5	Agree
		Disagree	4	23.5	47.1	
		Agree	7	41.2	88.2	
		Strongly agree	2	11.8	100.0	
		Total	17	100.0		

The table above show that most biology teachers face several constraints in implementing the CTCA approach. Key challenges include inadequate training, insufficient technological resources, rigid curriculum structures, and large class sizes. These

challenges collectively limit teachers' ability to effectively integrate CTCA in their instructional practices. Additionally, language barriers further hinder the full contextualization of biology lessons.

Discussion of Findings

Findings from this research shows that biology teachers of public senior secondary schools in Egor Local Government Area of Edo state are familiar with the concept of CTCA , but the findings also revealed that the teachers lack formal training on the application of CTCA in the classroom. This findings agrees with Okebukola et al (2022) who also discovered similar findings in their study where they posited that teachers awareness on CTCA was moderate but the teachers knowledge on CTCA was limited to the theoretical aspect. Ige et al (2025) also discovered similar findings and posited that teachers had moderate-to-high awareness of CTCA due to pre-study workshops, though their understanding was mostly theoretical and required more practical training.

The study also revealed that the degree of integration of CTCA principles in Biology teaching is modest but not extensive. While some teachers reported that sometimes they relate Biology concepts to students' cultural experiences and local contexts, most still rely on conventional teaching method. This findings agrees with the study of Ahanonye et al (2024) where they discovered that actual classroom use of indigenous knowledge is limited largely because of practical constraints which is due to challenges such as lack of culturally grounded curricular materials. Also, according to this research, the consistent use of technology tools by biology teachers remains limited due to insufficient

technological resources. This findings aligns with Ajayi et al (2021) who discovered in their study that the major limitations to ICT integration included poor or unstable Internet connectivity , insufficient or outdated hardware, lack of technical support, and low levels of teacher confidence and competence in ICT pedagogy.

Finally, the research identified several challenges that restrict the full implementation of CTCA in biology classrooms. Prominent among these are inadequate training opportunities, poor access to technological facilities, rigid curriculum structures, large class sizes and language barriers. These challenges reveal the systematic issues that prevent teachers from adopting CTCA widely, despite its potential to improve students' comprehension and engagement. This findings is supported by Okebukola et al (2022) who discovered that the key challenges in the implementation of CTCA included inadequate ICT infrastructure, time-consuming contextualization of content, resistance from some teachers, and misalignment with exam-focused instruction.

Therefore, the study concludes that the successful adoption of CTCA requires not only teacher willingness but also policy reforms, improved infrastructure, and consistent professional support to promote culturally responsive and technology-enhanced Biology education.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary of Findings

This study investigated the degree of application of the Culturo-Techno-Contextual Approach (CTCA) in the teaching of biology among secondary school teachers. The study focused on three key areas: the level of awareness of CTCA among biology teachers, the extent to which they integrate cultural, technological, and contextual elements into their classroom teaching, and the challenges they encounter in implementing CTCA.

The findings revealed that while a number of biology teachers are familiar with the concept of CTCA and its potential benefits in enhancing students' engagement and understanding, most of them lack formal training and theoretical knowledge of the approach. Many teachers admitted that they have not attended seminars, workshops, or professional development courses related to CTCA, which limits their practical application of the strategy. Additionally, a considerable percentage of teachers do not keep up with recent research or publications on CTCA, indicating low professional awareness and exposure.

In terms of integration, the study found that teachers moderately apply aspects of CTCA in their teaching. Several teachers indicated that they relate biological concepts to students' cultural experiences and local environments. However, the use of technology in classroom instruction remains limited due to inadequate access to educational resources,

such as projectors, computers, and reliable internet connections. Dele-Ajayi, Fasae and Okoli (2021) examined teachers' use of ICT in classroom instruction and found that although teachers appreciate the value of digital technologies, the actual level of classroom application remains very low. Most teachers rely mainly on basic tools such as mobile phones and standalone computers, while more advanced technologies like internet-based resources, projectors, and interactive platforms are rarely used. The study identified major barriers including poor internet connectivity, outdated equipment, inadequate technical support, and low teacher competence and confidence in ICT pedagogy.

Also, teachers from different indigenous backgrounds often struggle to integrate local Indigenous Knowledge (IK) in biology teaching. Their unfamiliarity with students' cultural practices and community-based knowledge makes it difficult to contextualize lessons effectively. Ahanonye et al. (2024) investigated how senior secondary life sciences teachers in peri-urban Nigerian schools understand Indigenous Knowledge (IK) and its integration into biology teaching. The study found wide variation in teachers' conceptions of IK, from inherited local wisdom to holistic systems encompassing ecological, spiritual, and social dimensions. These conceptions influence whether teachers attempt to integrate IK, with holistic views supporting broader classroom application.

Furthermore, the study identified major challenges that hinder the effective implementation of CTCA. These include lack of adequate training, poor technological

infrastructure, rigid curriculum structures that do not support flexible, culturally inclusive teaching methods, large class sizes, and language barriers that make it difficult to translate biological concepts into students' local contexts. Collectively, these findings indicate that while CTCA holds great potential for improving biology teaching and learning, its adoption remains constrained by systemic and institutional factors.

Conclusion

Based on the findings of this study, it can be concluded that the Culturo-Techno-Contextual Approach (CTCA) is yet to be fully understood and effectively implemented by biology teachers in secondary schools. Although teachers exhibit a positive attitude toward the concept and recognize its relevance in enhancing comprehension and learner engagement, their actual classroom practice reflects only partial integration. The limited awareness and application stem mainly from inadequate professional development opportunities and insufficient access to instructional technology.

It can also be concluded that systemic challenges such as poor infrastructure, large class sizes, and curriculum rigidity continue to pose serious obstacles to the practical application of CTCA. Moreover, language barriers and lack of localized teaching resources hinder teachers from contextualizing biology content to align with students' cultural backgrounds. For CTCA to achieve its intended educational outcomes, there is a pressing need for targeted interventions that strengthen teacher competence, promote technological integration, and reform curriculum practices to accommodate culture-based and contextualized learning strategies.

Recommendations

In light of the findings and conclusions of this study, the following recommendations are made:

- The Ministry of Education should collaborate with faculties of education in universities to organize regular workshops, seminars, and training sessions on the Culturo-Techno-Contextual Approach to build teachers' knowledge, skills and confidence in its application.
- Schools should be adequately equipped with modern instructional tools such as computers, projectors, internet facilities, and multimedia devices to support effective integration of the technological component of CTCA.
- The national and state curriculum planners should review the existing biology curriculum to allow more flexibility for the inclusion of cultural and contextual examples in lesson plans.
- Government and educational stakeholders should ensure reasonable class sizes that enable teachers to implement participatory and culturally inclusive methods of teaching, such as CTCA.
- Biology teachers should be encouraged to incorporate local knowledge systems, cultural practices, and indigenous examples in teaching to make learning more meaningful and relatable to students.

Contributions to Knowledge

This study proves that though biology teachers are aware of CTCA, they do not have knowledge of the application of CTCA in the teaching of biology in a classroom. Therefore, It identifies the gap between teachers' positive attitudes toward CTCA and their limited practical application of the approach in classroom settings due to challenges such as; poor infrastructure, rigid curricula, and language barriers.

Suggestions for Further Studies

Future researchers should consider exploring:

- The impact of CTCA-based teaching on students' academic performance and interest in biology.
- The comparative effectiveness of CTCA and traditional teaching methods across different science subjects.
- The influence of teachers' demographic variables (such as years of experience or qualification) on their ability to apply CTCA effectively.

REFERENCES

Achor, E., Egbonyi, N., & Akpan, P. (2018). Effects of culturally responsive teaching on students' achievement in biology. *Journal of Science Education*, 22(3), 45–56.

- Adam, A., Okebukola, P. A., & Awaah, F. (2025). Bridging culture and science: Culturo-Techno-Contextual Approach in culturally relevant biology pedagogy. *Voprosy obrazovaniya / Educational Studies Moscow*, *118(2)*, 100–115.
- Adam, U. A., Adeyemi, D., Lameed, S. N., Mustapha, A. G., & Abolaji, T. J. (2024). Decolonizing biology classrooms in Nigeria: The significance of the Culturo-Techno-Contextual Approach. *Erudio Journal of Educational Innovation*, *11(2)*, 173–186.
- Adams, T. (2022). Teacher readiness for the application of the Culturo-Techno-Contextual Approach in Nigerian secondary schools. *Nigerian Journal of Science Education*, *10(1)*, 12–25.
- Adebayo, F., & Ilesanmi, T. (2018). Repositioning biology education for career readiness in health sciences. *Nigerian Journal of Science Education*, *6(2)*, 45–53.
- Adebayo, S. (2023). Integration of mobile technology in biology teaching: Implications for active learning. *International Journal of Educational Technology*, *8(1)*, 102–117.
- Adesanya, O., & Oloyede, J. (2020). Professional development and teacher effectiveness in science education. *African Journal of Teacher Education*, *15(2)*, 78–91.
- Ahanonye, F. U. A., Otulaja, O., Risenga, I., & Dukhan, S. (2024). Understanding Indigenous Knowledge and its integration into biology teaching in Nigerian secondary schools. *African Journal of Research in Mathematics, Science and Technology Education*, *28(2)*, 145–162.
- Awaah, F., Adam, A., & Okebukola, P. A. (2023). Decolonizing biology classrooms in Nigeria: The significance of Culturo-Techno-Contextual Approach (CTCA).
- Awaah, F., Okebukola, P. A., Shabani, J., Taiwo, H., Gbeleyi, O., & Tetteh, A. (2023). Exploratory study of the efficacy of the Culturo-Techno-Contextual Approach (CTCA) in students' understanding of biology. *The Journal of Educational Research*, *116(3)*, 125–133.
- Campbell, N. A., Reece, J. B., & Mitchell, L. G. (2019). *Biology (12th ed.)*. Pearson Education.
- Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education (8th ed.)*. Routledge.

- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches (4th ed.)*. SAGE Publications.
- Dele-Ajayi, F., Fasae, F. O., & Okoli, A. (2021). Teachers' concerns about integrating information and communication technologies in the classrooms. *PLoS ONE*, *16(5)*, e0249703.
- Dele-Ajayi, F., Fasae, F. O., & Okoli, A. (2021). Teachers' use of ICT in classroom instruction and the challenges limiting effective integration. *PLoS ONE*, *16(5)*.
- Ede, T., & Okonkwo, J. (2019). Culturally responsive teaching strategies in science education. *Journal of Science Teaching*, *18(2)*, 34–47.
- Egbonyi, N., & Akpan, P. (2020). Awareness and application of CTCA in Nigerian secondary schools. *African Journal of Science Education*, *12(3)*, 56–70.
- Eze, E. I., & Ekwueme, C. O. (2022). Effectiveness of culturally contextualized digital tools in enhancing students' performance in science subjects. *Journal of Science Education and Innovation*, *10(1)*, 88–97.
- Farrant, J. S. (2004). *Principles and practice of education (New ed.)*. Longman.
- Gagné, R. M. (1985). *The conditions of learning (4th ed.)*. Holt, Rinehart and Winston.
- George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference (4th ed.)*. Allyn & Bacon.
- Ige, F., Owolabi, T., Onowugbeda, M., & colleagues. (2025). Impact of the Culturo-Techno-Contextual Approach on students' achievement in plant nutrition. *Nigerian Journal of Science and Technology Education*, *29(1)*, 88–104.
- Joshi, A., Kale, S., Chandel, S., & Pal, D. K. (2015). Likert scale: Explored and explained. *British Journal of Applied Science & Technology*, *7(4)*, 396–403.
- Kothari, C. R. (2004). *Research methodology: Methods and techniques (2nd ed.)*. New Age International Publishers.
- Miller, K. R., & Levine, J. (2016). *Biology (Foundation ed.)*. Pearson Education.
- Nwagbo, C. R. (2008). Science, technology, and mathematics education for sustainable development. *Nigerian Journal of Curriculum Studies*, *15(2)*, 20–28.

- Nworgu, B. G. (2015). *Educational research: Basic issues and methodology (3rd ed.)*. University Trust Publishers.
- Ogbu, C. C. (2018). The culturo-techno-contextual approach: An emerging framework in science teaching in Africa. *International Journal of Science Pedagogy*, 5(3), 21–30.
- Ogunniyi, M., & Ogunkola, B. (2019). Context-based teaching in science education: Linking concepts to real-life experiences. *Journal of Science Curriculum*, 17(1), 12–29.
- Okafor, O. P., & Nwafor, C. E. (2021). Culturally responsive pedagogy and the use of technology in Nigerian classrooms. *Journal of Educational Trends*, 11(3), 102–111.
- Okafor, U., & Eze, P. (2021). Challenges in implementing context-based and culturally responsive teaching in biology classrooms. *African Journal of Educational Research*, 13(2), 65–79.
- Okebukola, P. A., Adegbile, J., & colleagues. (2022). Application of CTCA in teaching genetics in senior secondary schools in Nigeria. *Nigerian Journal of Science Education*, 21(4), 55–72.
- Okebukola, P. A., Ige, F., Lameed, T., Agbanimu, R., & Adam, S. (2024). Effect of the Culturo-Techno-Contextual Approach on students' retention of variation and evolution concepts in biology. *African Journal of Science Education*, 26(1), 33–50.
- Okeke, A. U. (2020). *Biology for Nigerian secondary schools*. Golden Press Educational Publishers.
- Onowugbeda, F. U., Okebukola, P. A., Ige, A. M., Lameed, S. N., Agbanimu, D. O., & Adam, U. A. (2024). A cultural, technological, and contextual pedagogy to enhance retention of biology concepts. *The Journal of Educational Research*, 117(2), 49–60.
- Onuoha, C. J. (2020). Adoption of culturo-techno-contextual teaching in senior secondary biology: An experimental study. *Nigerian Journal of Science Education*, 8(1), 55–68.
- Orodho, J. A. (2003). *Essentials of educational and social science research methods*. Masola Publishers.

- Singh, A. S., & Masuku, M. B. (2014). Sampling techniques and determination of sample size in applied statistics research: An overview. *International Journal of Economics, Commerce and Management*, 2(11), 1–22.
- Sustainability Review. (2022). Breaking barriers to meaningful learning in STEM subjects in Africa: A systematic review of the CTCA approach. *Sustainability*, 17(5), 2310.
- Taylor, M. J. (2018). Introduction to biology: Understanding life and its processes. *ScienceBridge Publishers*.
- Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. *Harvard University Press*.
- West African Examinations Council (WAEC). (2020–2024). *Chief examiners' reports on biology. WAEC*.
- West African Examinations Council (WAEC). (2023). *Annual chief examiners' report. WAEC*.

APPENDICES:

DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY

(CIT) UNIVERSITY OF BENIN

Questionnaires

Title: Degree of Application of the Culturo-Techno-Contextual Approach (CTCA) in the Teaching of Biology.

Instructions: Please answer all questions honestly. Your responses will remain confidential and will be used solely for academic research purpose. Kindly tick[] the option that best applies.

Section A: Demographic information

1. Gender Male Female

2. Highest Academic Qualification

NCE OND/HND

B.Sc. B.Ed. Post Graduate Diploma PGD M.Sc.

M.Ed.

Ph.D.

Other (specify) _____

4. Years of Teaching Experience

0–4 years 5–9 years 10–14 years

15–19 years 20 years and above

Section B: Awareness Of CTCA

Instruction: Tick[✓] the box that best reflects your level of agreement with each statement

S/N	STATEMENT	Strongly Agree	Agree	Disagree	Strongly Disagree
1.	I am familiar with the concept of the Culturo-Techno-Contextual Approach (CTCA) in science teaching.				
2.	I have received formal training (seminars, workshops, or courses) on CTCA.				
3.	I understand the theoretical foundations (culture, technology, and context) underlying CTCA.				
4.	I am aware of the benefits of CTCA in improving students' comprehension and engagement in biology.				
5.	I keep up with recent publications or discussions on CTCA in Nigerian education.				

SECTION C: Integration Of CTCA In Biology Teaching

Instruction: Tick[✓] the box that best reflects your level of agreement with each statement

S/N	STATEMENT	Strongly Agree	Agree	Disagree	Strongly Disagree
1.	I relate biological concepts to students' cultural experiences (e.g., family lineage, local traditions, indigenous practices).				
2.	I use examples from students' immediate environment (local farming, health practices, or natural resources, etc) to explain biology concepts.				
3.	I employ technology tools such as projector, multimedia, or internet resources to enhance biology lessons.				
4.	I invite and consult elders, community practices, or indigenous knowledge as part of my instructional resources for learning				

	biology.				
5.	I design lesson plans that combine cultural relevance, technological tools, and local context when teaching biology.				

Section D: Challenges in Implementing CTCA

Instruction: Tick[✓] the box that best reflects your level of agreement with each statement

S/N	STATEMENT	Strongly Agree	Agree	Disagree	Strongly Disagree
1.	I lack adequate training or professional development on how to implement CTCA.				
2.	My school has limited access to technological resources (e.g., internet, projectors, or computers) needed for CTCA.				
3.	The curriculum structure does not provide enough flexibility to integrate cultural and contextual examples in biology teaching.				
4.	Large class sizes make it difficult to effectively apply CTCA principles in the classroom.				
5.	Language barriers or difficulties in translating biological concepts into local languages hinder CTCA implementation.				