

CULTURAL CONFLICTS ON ACQUISITION OF SCIENTIFIC KNOWLEDGE IN BIOLOGY

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ABSTRACT

Biology education is not culturally neutral; rather, it is deeply influenced by learners' cultural backgrounds, beliefs, values, and indigenous knowledge systems. This seminar critically examines how cultural context shapes the teaching and learning of Biology, particularly in multicultural and developing societies where diverse worldviews intersect with formal scientific knowledge. It explores the interaction between scientific knowledge and indigenous knowledge systems, learners' epistemological beliefs, language of instruction, and classroom practices, emphasizing how these factors influence students' understanding of biological concepts. The review highlights that culturally familiar examples, local environmental knowledge, and community-based experiences can significantly enhance learning outcomes. Findings reveal that when cultural contexts are effectively integrated into Biology education, learners demonstrate improved conceptual understanding, higher engagement, better retention, and increased relevance of scientific knowledge to real-life situations. Conversely, when cultural perspectives are ignored, learners may develop misconceptions, experience cognitive conflict, and become disengaged from the learning process. The seminar concludes that culturally responsive Biology teaching is essential for meaningful and inclusive science education. It recommends curriculum adaptation, continuous teacher training, and the deliberate integration of indigenous knowledge systems to bridge the gap between traditional understanding and modern scientific perspectives.

Keywords: Indigenous, Culturally Responsive Teaching, Culture, Biology, Value.

1.0 Introduction

Biology, as a fundamental branch of science, is concerned with the systematic study of living organisms, their structure, functions, growth, evolution, distribution, and interactions with both living and non-living components of the environment. It is one of the core science subjects in secondary and tertiary education because it provides learners with essential knowledge needed to understand life processes, health, agriculture, environmental sustainability, and biotechnology. Although Biology is built on universal scientific principles and empirical investigation, its teaching and learning are not culturally neutral. Instead, they are deeply embedded in the cultural environment in which learners live and the educational system in which instruction takes place (Aikenhead, 2017; Ogunniyi, 2019).

Cultural context refers to the totality of values, beliefs, norms, languages, traditions, and worldview that shape how individuals interpret reality. In the context of education, culture influences how students perceive knowledge, how teachers present content, and how classroom interactions are structured. In Biology education, cultural context plays a particularly important role because many biological concepts are directly linked to everyday human experiences such as birth, death, disease, food production, environmental conservation, and human behaviour. As a result, students do not approach Biology as “blank slates”; rather, they come into the classroom with prior knowledge shaped by their cultural background (Gay, 2018; Ladson-Billings, 2021).

In many African societies, including Nigeria, learners enter Biology classrooms with well-established indigenous knowledge systems that attempt to explain natural and biological phenomena. These indigenous systems are not random beliefs; rather, they are structured ways of understanding the world developed over generations through observation, experience, and cultural transmission. For instance, traditional explanations of disease causation may include spiritual, supernatural, or environmental interpretations. Similarly, reproductive processes, inheritance, and ecological relationships may be explained in ways that differ from modern scientific accounts. While formal Biology explains disease in terms of pathogens such as bacteria, viruses, and protozoa, some cultural perspectives may attribute illness to spiritual attacks, ancestral displeasure, or moral wrongdoing. Likewise, concepts such as reproduction and heredity may be interpreted through cultural or religious frameworks rather than Mendelian genetics (Khupe & Keane, 2017; Abah, 2020).

These culturally rooted explanations often interact with scientific knowledge introduced in the classroom, leading to either meaningful integration or cognitive conflict. When properly integrated, indigenous knowledge can serve as a bridge to scientific understanding, helping learners connect abstract concepts to familiar experiences. However, when there is a sharp contradiction between cultural beliefs and scientific explanations, students may experience conceptual confusion, resistance to learning, or reliance on rote memorization without true understanding. This tension is particularly evident in topics such as evolution, genetics, disease transmission, and classification of living organisms (Duit & Treagust, 2017; Potvin et al., 2020).

The classroom environment itself is also influenced by cultural context. Teaching methods, teacher authority, communication patterns, and student participation are often shaped by societal norms. In some cultures, learners are expected to be passive recipients of knowledge, showing respect by not questioning the teacher. In such environments, inquiry-based learning—a key approach in science education—may be limited. This can restrict students’

ability to critically engage with Biology concepts, thereby affecting their scientific reasoning and problem-solving skills (OECD, 2019; Hofstede Insights, 2020).

The language of instruction is another important cultural factor influencing Biology education. In many multilingual societies, including Nigeria, Biology is often taught in English, which may not be the first language of many students. This language gap can make it difficult for learners to fully grasp complex scientific terminology and abstract concepts. Words such as “photosynthesis,” “osmosis,” “metabolism,” and “homeostasis” may not have direct equivalents in local languages, making comprehension more challenging. As a result, students may memorize definitions without fully understanding the underlying biological processes (UNESCO, 2020; Okebukola, 2021).

The theoretical foundation for understanding the influence of cultural context on learning can be traced to the work of Lev Vygotsky. Vygotsky’s sociocultural theory emphasizes that learning is fundamentally a social process, mediated by cultural tools such as language, symbols, and interaction with more knowledgeable others. According to this perspective, cognitive development does not occur in isolation but is shaped by the learner’s social and cultural environment. In Biology education, this implies that students construct understanding based on both classroom instruction and their prior cultural experiences.

Similarly, culturally relevant education has been widely emphasized in contemporary research, highlighting that learning becomes more meaningful when new knowledge is connected to learners’ cultural backgrounds. From a constructivist perspective, students actively construct knowledge rather than passively receive it, and this process is strongly influenced by prior knowledge, which is largely shaped by culture. Recent studies affirm that integrating learners’ cultural experiences into teaching enhances understanding, engagement, and knowledge retention. This implies that when Biology is taught without consideration of students’ cultural contexts, it often becomes abstract, difficult to relate to, and disconnected from real-life experiences. Consequently, learners may struggle to internalize scientific concepts or apply them meaningfully in everyday situations (Gay, 2018; Ladson-Billings, 2021; UNESCO, 2020). Therefore, the influence of cultural context on Biology education is both profound and multifaceted. It affects cognition, language, pedagogy, curriculum interpretation, and learner motivation. Understanding this relationship is essential for improving Biology teaching practices, especially in culturally diverse classrooms. Rather than viewing culture as a barrier to scientific learning, it should be seen as a resource that can enrich Biology education and promote deeper conceptual understanding.

2.0 Concept of Cultural Context in Education

Cultural context in education refers to the complex and dynamic system of shared meanings, values, beliefs, customs, traditions, and ways of knowing that shape how individuals perceive, interpret, and respond to educational content. It encompasses both visible elements of culture—such as language, dress, and social practices—and invisible elements such as worldview, belief systems, epistemology (how knowledge is understood), and attitudes toward authority, learning, and knowledge production. In essence, cultural context provides the “lens” through which learners and teachers make sense of educational experiences.

Education does not occur in a vacuum; it is deeply embedded within society. Every educational system reflects the culture in which it operates, and learners bring their cultural backgrounds into the classroom. These backgrounds influence how students interpret new information, how they relate it to prior knowledge, and how they apply it in real-life

situations. As Cobern and Cultural context plays a central role in shaping science learning because students often have to navigate between their everyday cultural worldview and the scientific worldview presented in school. Contemporary research emphasizes that this “border crossing” between different knowledge systems can either support or hinder understanding depending on how well instruction connects the two perspectives. When teachers acknowledge and integrate students’ cultural backgrounds, learning becomes more meaningful and less conflicting. However, when these cultural perspectives are ignored, students may experience difficulty reconciling scientific concepts with their prior beliefs, leading to confusion or disengagement (Aikenhead, 2017; Khupe & Keane, 2017; Ogunniyi, 2019).

In educational settings, cultural context influences curriculum interpretation in significant ways. Although curricula are often designed to be standardized, their implementation varies depending on cultural realities. Teachers may interpret and deliver the same curriculum differently based on their own cultural understanding and the cultural background of their students. Similarly, learners may interpret the same content differently depending on whether it aligns with or contradicts their cultural beliefs. For instance, a Biology curriculum that explains human reproduction strictly in biological terms may be interpreted differently by students whose cultural background includes spiritual or symbolic explanations of conception and birth. This difference in interpretation can influence how well students understand, accept, or retain scientific concepts.

Cultural context also strongly affects teacher-student interaction. In many cultures, including several African societies, education is traditionally teacher-centered, with the teacher viewed as an authority figure whose knowledge is not to be questioned. This cultural expectation can influence classroom communication patterns, limiting student participation, inquiry, and critical thinking. In contrast, modern science education emphasizes learner-centered approaches, where students are encouraged to ask questions, investigate problems, and construct their own understanding. The interaction between these two cultural expectations can either enhance or hinder effective teaching, depending on how well the teacher manages cultural differences in the classroom.

Furthermore, cultural context influences students’ attitudes toward learning and knowledge acquisition. Students from different cultural backgrounds may have different beliefs about what counts as “valid knowledge.” In some cultures, knowledge derived from elders, tradition, or religion is considered highly authoritative, while in science education, empirical evidence, experimentation, and observation are emphasized. This difference can create tension when students are required to accept scientific explanations that differ from their culturally inherited beliefs. For example, in Biology, the concept of evolution may conflict with creation-based beliefs held in some cultural or religious communities. Such conflicts can influence students’ willingness to accept scientific explanations, even when they are academically required to learn them.

In Biology education specifically, cultural context plays a crucial role in shaping how learners connect scientific concepts to their everyday experiences. Biological phenomena such as reproduction, inheritance, disease transmission, nutrition, and ecological relationships are often already interpreted within cultural frameworks before formal schooling begins. For instance, in some communities, illness may be attributed to supernatural causes or spiritual imbalance, while Biology explains it in terms of pathogens and physiological processes. Similarly, environmental conservation practices may be rooted in traditional beliefs about

sacred forests or ancestral land protection, which align in some ways with modern ecological principles but differ in explanation and reasoning.

The concept of cultural context is also closely related to epistemology in education—that is, the study of how knowledge is constructed and validated. Western science education typically emphasizes empirical evidence, experimentation, and logical reasoning. In contrast, many indigenous knowledge systems emphasize experiential learning, oral tradition, and communal validation of knowledge. When students transition between these two systems of knowledge, they are essentially engaging in what has been described as “cultural border crossing” in science learning. This process requires learners to navigate and switch between different ways of understanding the world—one rooted in their everyday cultural experiences and the other in formal scientific explanations—which can be cognitively demanding. Recent studies emphasize that without adequate instructional support, this transition may lead to confusion, resistance, or fragmented understanding. However, when teachers deliberately guide students through this process by connecting indigenous knowledge with scientific concepts, learners are better able to reconcile differences and achieve deeper conceptual understanding (Aikenhead, 2017; Khupe & Keane, 2017; Ogunniyi, 2019).

Another important dimension of cultural context in education is language. Language is not only a means of communication but also a carrier of culture. The language used in teaching Biology significantly affects how students interpret concepts. Scientific terminology is often abstract and difficult to translate directly into local languages, which can create barriers to understanding. When instruction is delivered in a language that is not the learner’s mother tongue, cognitive load increases, and students may struggle to fully grasp complex ideas. This highlights the importance of culturally responsive language practices in education.

2.1 Indigenous Knowledge Systems and Biology Learning

Indigenous Knowledge Systems (IKS) refer to the accumulated body of knowledge, practices, skills, and beliefs developed by local communities over long periods of interaction with their natural environment. This knowledge is transmitted across generations through oral tradition, observation, participation, and cultural practice rather than through formal written documentation. Indigenous knowledge is deeply embedded in the social, cultural, spiritual, and environmental life of a community, making it an integral part of how people interpret and respond to the world around them.

In the context of Biology learning, Indigenous Knowledge Systems play a significant role because they provide learners with prior explanations of biological phenomena before formal scientific instruction begins in school. These systems include traditional medicine practices, agricultural methods, ecological conservation strategies, animal classification systems, weather prediction techniques, and cultural explanations of human development and disease. For example, many rural communities possess detailed knowledge of medicinal plants used for treating various ailments. Such knowledge often includes information about plant identification, preparation methods, dosage, and perceived effectiveness, even though it may not be documented using scientific terminology.

Indigenous knowledge also includes ecological understanding, such as seasonal changes, animal behavior patterns, soil fertility indicators, and natural resource management practices. Farmers, for instance, may rely on traditional indicators like bird migration patterns, flowering of certain plants, or insect behavior to predict rainfall or agricultural productivity. These observations, while not formally categorized within scientific frameworks, often

demonstrate a high level of environmental awareness developed through continuous interaction with nature.

The idea of “cultural border crossing” explains how students move between Indigenous Knowledge Systems and Western scientific knowledge during learning. This process involves transitioning between their everyday cultural worldview and the scientific worldview presented in formal education, each of which operates with distinct assumptions, languages, and methods of explaining phenomena. Indigenous knowledge is often holistic, context-based, and shaped by communal and sometimes spiritual interpretations, whereas Western science tends to be reductionist, empirical, and grounded in systematic observation and experimentation. Recent studies affirm that these differences can create both opportunities and challenges in science learning. When effectively mediated by teachers, the interaction between these knowledge systems can enrich understanding; however, when poorly handled, it may result in cognitive conflict or misunderstanding (Aikenhead, 2017; Khupe & Keane, 2017; Ogunniyi, 2019; Abah, 2020).

2.2 Language of Instruction and Biology Education

Language is one of the most powerful cultural tools in education because it serves as the primary medium through which knowledge is transmitted, interpreted, and constructed. In Biology education, language is not only a vehicle for communication but also a determinant of how well learners understand scientific concepts. The language of instruction can either facilitate meaningful learning or create significant barriers to comprehension, depending on how closely it aligns with the learners’ linguistic and cultural background.

Language plays a critical role in science learning, particularly in multilingual contexts where students are taught in a second or third language. Research shows that learning science under such conditions can hinder comprehension, especially when dealing with abstract and conceptually demanding topics. In Biology, where understanding often depends on the ability to visualize processes and interpret relationships between organisms and their environment, language barriers can significantly limit students’ conceptual clarity. Learners may struggle with scientific vocabulary, misinterpret key concepts, or rely on memorization rather than genuine understanding. Recent studies highlight that the use of unfamiliar language in instruction can widen learning gaps and reduce academic performance unless supported with culturally and linguistically responsive teaching strategies (UNESCO, 2020; Okebukola, 2021; Olagunju, 2022).

Language challenges in Biology education are not limited to terminology alone. Sentence structure, instructional style, and classroom discourse also play important roles. Scientific explanations often involve complex sentence constructions, passive voice, and specialized vocabulary that may not be commonly used in everyday communication. For example, explaining processes such as “cellular respiration involves the breakdown of glucose molecules in the presence of oxygen to release energy” requires both linguistic competence and conceptual understanding. Students who struggle with the language may misinterpret or oversimplify such explanations.

2.3 Cultural Beliefs and Misconceptions in Biology

Cultural beliefs are deeply rooted explanations of natural phenomena shaped by tradition, religion, social norms, and communal experiences. These beliefs influence how individuals interpret biological phenomena such as health, reproduction, heredity, and environmental

interactions. While they provide social identity and cultural meaning, some cultural beliefs may conflict with scientific explanations taught in Biology, thereby contributing to misconceptions among learners (Oludipe & Aina, 2018; Mbah et al., 2019; Yusuf & Bello, 2021).

In Biology education, misconceptions refer to understandings that differ from scientifically accepted explanations. These are often not mere errors, but deeply held beliefs formed through family upbringing, indigenous knowledge systems, and social practices. Learners frequently bring such pre-existing ideas into the classroom, and these can shape how they interpret biological concepts. Where cultural interpretations differ from scientific explanations, students may develop resistance to conceptual change or retain alternative conceptions despite instruction (Duit & Treagust, 2018; Achor et al., 2020; Olorundare, 2022).

One important area where cultural beliefs influence misconceptions is disease causation. In many communities, illness may be attributed to witchcraft, curses, spiritual attacks, or ancestral displeasure. For example, epilepsy may be interpreted as spirit possession, while some mental illnesses are viewed as supernatural afflictions rather than neurobiological disorders. Similarly, malaria may be associated with excessive sun exposure or eating oily foods instead of mosquito transmission, while cholera outbreaks may be linked to spiritual contamination rather than bacterial infection and poor sanitation (Mbah et al., 2019; Ezeh et al., 2020; WHO, 2021). Such beliefs can conflict with scientific explanations of pathogens, vectors, and disease transmission, thereby reinforcing misconceptions in Biology.

Cultural misconceptions also affect understanding of genetics and heredity. In some communities, conditions such as albinism are still associated with curses or supernatural forces rather than genetic inheritance (Bain et al., 2020; Cruz-Inigo et al., 2021). Similarly, the misconception that mothers alone determine the sex of a child persists in some cultural settings, contradicting scientific explanations involving sex chromosomes. Hereditary disorders such as sickle cell disease may also be interpreted as spiritual punishment or destiny rather than outcomes of inherited genes (Adigwe et al., 2019; Nwafor & Eze, 2022). These beliefs may hinder learners' understanding of Mendelian genetics and inheritance patterns.

Reproductive Biology is another domain where cultural beliefs contribute to misconceptions. Menstruation is often surrounded by myths portraying menstruating females as impure or physically restricted, which can distort understanding of menstrual physiology. In some contexts, infertility is culturally viewed as solely a woman's problem, ignoring male reproductive factors. Misconceptions also exist that contraceptives cause permanent infertility or severe bodily damage, affecting students' acceptance of reproductive health concepts (Kabagenyi et al., 2018; Kaur et al., 2020; UNICEF, 2022).

Evolution and origins of life represent areas where sociocultural and religious beliefs frequently intersect with Biology misconceptions. Some learners resist evolutionary explanations because they perceive them as incompatible with religious doctrines, leading to misconceptions about natural selection, adaptation, and speciation. For instance, the erroneous belief that humans evolved directly from monkeys rather than sharing common ancestry reflects both conceptual and cultural misunderstandings (Barnes et al., 2020; Mead et al., 2021; Yates & Marek, 2022).

Cultural beliefs also influence misconceptions in ecology and environmental Biology. In some communities, drought, floods, or pest outbreaks may be attributed to displeased spirits

or ritual violations rather than ecological imbalance or climate processes. Certain animals such as owls, bats, or snakes may be associated with omens or witchcraft, leading to distorted understanding of their ecological importance. Likewise, some learners may underestimate the biological consequences of deforestation or biodiversity loss because of traditional assumptions about inexhaustible natural resources (UNEP, 2020; Adekunle et al., 2021; FAO, 2022).

Nutrition and health practices provide further examples. Some cultural beliefs discourage pregnant women or children from consuming protein-rich foods such as eggs or fish due to myths that they cause undesirable traits or delivery complications. Such beliefs may foster misconceptions about nutrient functions, balanced diets, and human physiology (Adebayo et al., 2019; FAO, 2022; Okeke & Ibrahim, 2023).

These examples show that cultural beliefs can serve as important sources of alternative conceptions in Biology. Although such beliefs may have social significance, they may hinder scientific understanding when uncritically transferred into science learning. Biology education therefore requires culturally responsive instructional approaches that acknowledge learners' backgrounds while guiding them toward scientifically accurate explanations. Through conceptual change strategies, contextual teaching, and inquiry-based learning, teachers can help students reconcile cultural interpretations with biological knowledge (Achor et al., 2020; Olorundare, 2022; Yusuf & Bello, 2021).

2.4 Curriculum Design and Cultural Relevance

Curriculum design refers to the systematic process of selecting, organizing, and presenting educational content in a way that facilitates effective teaching and learning. In Biology education, curriculum design determines what biological concepts are taught, how they are sequenced, and the instructional approaches used to deliver them. However, beyond content selection and organization, curriculum design is increasingly recognized as a culturally embedded process that should reflect the lived experiences, values, and environmental realities of learners. This is where the concept of cultural relevance becomes essential.

A culturally responsive or culturally relevant curriculum is one that deliberately integrates learners' cultural backgrounds, indigenous knowledge, and local environmental contexts into formal educational content. Such a curriculum recognizes that students do not come into the classroom as empty vessels; rather, they bring prior knowledge shaped by their culture, community practices, and everyday experiences. When this prior knowledge is acknowledged and incorporated into teaching, learning becomes more meaningful, engaging, and effective.

UNESCO (2017) emphasizes that science education should be inclusive, equitable, and context-based. This means that Biology curriculum should not only focus on universal scientific principles but should also reflect local realities in which learners live. In doing so, students are better able to connect abstract scientific concepts with tangible experiences from their environment. This approach enhances comprehension, retention, and application of knowledge in real-life situations.

2.5 Teacher's Role in Culturally Responsive Biology Teaching

Teachers occupy a central and indispensable position in the teaching and learning process, particularly in Biology education where abstract concepts, technical vocabulary, and culturally sensitive topics are frequently encountered. In culturally diverse classrooms, the

Biology teacher does not merely function as a transmitter of scientific knowledge but also as a mediator between scientific understanding and students' cultural worldviews. This mediating role is critical because learners often interpret scientific concepts through the lens of their prior cultural experiences, beliefs, and values.

2.6 Socioeconomic and Environmental Contexts

Socioeconomic and environmental contexts are important dimensions of cultural context that significantly influence Biology education. While culture is often understood in terms of beliefs, language, and traditions, it is also shaped by the economic conditions and physical environments in which learners grow and interact. These factors affect students' access to educational resources, their exposure to natural phenomena, and the types of experiential knowledge they bring into the classroom. As a result, Biology learning outcomes are not determined solely by curriculum content or teaching methods but are also strongly influenced by learners' socioeconomic and environmental realities.

Socioeconomic context refers to the social and economic conditions that shape individuals' lives, including income level, occupation, educational background of parents, and access to basic amenities such as electricity, clean water, healthcare, and learning materials. Students from high socioeconomic backgrounds often have greater access to textbooks, digital learning resources, laboratory equipment, and private tutoring. In contrast, students from low socioeconomic backgrounds may have limited access to these educational supports, which can affect their academic performance in Biology. However, it is important to note that low socioeconomic status does not necessarily equate to lack of knowledge; rather, it often results in different types of knowledge acquisition, particularly experiential and practical knowledge gained from daily life activities.

3.0 Conclusion

Cultural context significantly influences Biology education by shaping learners' understanding, interpretation, and engagement with scientific concepts. While indigenous knowledge systems and cultural beliefs can sometimes lead to misconceptions, they also provide valuable experiential knowledge that can enhance learning when properly integrated.

The study concludes that Biology education becomes more effective when it is culturally responsive, context-based, and inclusive of learners' backgrounds. Teachers and curriculum developers must therefore recognize culture as an essential component of science education rather than an external influence.

4.0 Suggestions

Based on the discussion, the following suggestions were made:

1. **Integration of Indigenous Knowledge Systems:** Biology curriculum should incorporate relevant indigenous knowledge to bridge the gap between science and culture.
2. **Teacher Training and Development:** Teachers should be trained in culturally responsive pedagogy and strategies for managing cultural misconceptions.
3. **Use of Local Examples and Contexts:** Biology lessons should include familiar plants, animals, and environmental situations to improve understanding.

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