# Framing Towards Culturally Relevant Practice in Nigeria High School Physics Education

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Physics education in Nigeria is often critiqued for being overly theoretical and disconnected from students' cultural contexts and everyday lives. While students struggle to relate physics concepts to their lived experiences, teachers themselves are frequently blamed for lacking innovative or student-centered approaches. However, this perspective often overlooks the colonial legacies and systemic barriers that shape how teachers were trained and the resources available to them. This study uses interviews with two in-service physics teachers in Nigeria to examine how they navigate these constraints and strive to reframe physics teaching in ways that resonate with their students. Drawing on framing theory, culturally relevant pedagogy (CRP), and the concept of coloniality, the findings reveal that while the curriculum and professional development continue to privilege Western epistemologies and canonical physics knowledge, teachers are finding creative and culturally rooted ways to make physics more relevant and meaningful. Teachers like Obi and Esther leverage students' local knowledge, whether it be farming practices, musical traditions, or community challenges to build bridges between textbook content and real-world applications. Yet, this culturally relevant work remains largely informal and teacher-driven, occurring in the margins of a system still structured by colonial assumptions about what counts as valid scientific knowledge. This study argues for a reimagining of physics education in Nigeria that moves beyond deficit views of teachers, instead foregrounding the agency and resourcefulness of teachers as they negotiate and reframe physics in their classrooms.

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## I. INTRODUCTION

Teachers in Nigeria are often blamed when students struggle with physics, with critics suggesting they simply have deficit mindsets about students or fail to teach in engaging ways [1,2]. Yet, much less attention is paid to the colonial legacies and systemic structures that shape how teachers themselves were trained and the resources they have access to. Teachers' resistance to incorporating indigenous knowledge, for example, has been linked to how teacher preparation and the national curriculum still prioritize Western epistemologies [3]. Teachers are caught in a tension: while they may recognize that physics feels disconnected from students' lives, they work within systems that rarely value or support culturally relevant practices.

Research has clearly documented how teachers in African, specifically Nigeria, often adopt a universal approach to teaching physics, viewing science as neutral and culturally unmarked. However, there is still a gap in understanding how teachers frame physics knowledge in their classrooms within these colonial legacies and whether they are striving to make a difference in these systemic barriers. Are they simply replicating a system that excludes cultural knowledge, or are they finding ways to reframe physics to be more culturally relevant and locally meaningful?. It is argued that true transformation in science education requires first recognizing and interrogating these deeply entrenched frameworks, rather than dismantling them indiscriminately [4]. This study takes up that call by focusing on how Nigerian physics teachers navigate this colonial inheritance in their everyday classroom practices, asking whether and how they resist, adapt, or reframe physics teaching to better reflect students' cultural identities and community knowledge.

## II. LITERATURE REVIEW

A well-known global trend is the persistent lack of achievement in physics education, which poses a critical challenge to the development of scientific human resources. A significant decline in student enrollment in science-related fields in Nigeria has been observed over the past two decades [5]. Scholars have presented several arguments to advance the teaching and learning of physics. For instance, fostering a shift from a teacher-centered model to a more student-centered approach [6], advocating for collaborative learning and the integration of frequent laboratory activities into regular physics lessons [7]. In addition, the importance of fostering creativity by occasionally allowing students to explore their own scientific interests and design experiments is emphasized [7]

While we agree that these are powerful strategies that physics teachers need to consider, especially in ways that connect to culturally relevant pedagogy (CRP). By CRP, we mean teaching practices that recognize and include students' cultural knowledge, languages, and everyday experiences in physics instruction, making learning more relevant and relatable to their lives [8]. It is essential to also recognize the systemic limitations that constrain their implementation. These limitations are deeply rooted in the enduring influence of coloniality. The sociopolitical context in which these ideas are applied significantly influences their effectiveness [1].

Colonialism was not only a project of physical domination but also a cultural and mental imposition [9]. Colonizers sought to control the minds of the colonized, shaping how they viewed themselves and the world [9]. This process continues today through education systems that privilege Western knowledge as universal and superior, while dismissing indigenous knowledge systems as primitive or irrelevant [11]. By examining the political and social forces that shape knowledge production, we can begin to challenge this dominance and create space for other ways of knowing. The framing of knowledge itself must be interrogated because it shapes what counts as valid or legitimate in the classroom [12].

The Nigerian National Policy on Education [13] states that secondary school physics education should prepare students for meaningful participation in society and help them thrive in a changing world. One way the government has attempted to achieve this is by partnering with international donors to revise the physics curriculum. This financial and epistemic leverage subtly shapes the mindset of teachers, encouraging the adoption of Western ways of knowing and embedding so-called universal physics teaching methods in the classroom. In doing so, it often silences how marginalized students think, know, and do science in their own terms [14].

Teachers work within complex frames influenced by their own educational experiences, professional training, and institutional context [15]. These frames shape instructional choices, whether to emphasize inquiry-based learning, focus on rigid content delivery, or strive for cultural relevance, and ultimately affect how knowledge is presented in the classroom [16]. Even teachers committed to equity face the reality that their instructional practices are deeply shaped by the cultural, political, and economic conditions around them [17].

This study examines how systemic and colonial forces influence physics teaching in Nigeria, and how teachers navigate these forces in their day-to-day practice. We are particularly interested in whether elements of culturally relevant pedagogy are already being taken up, even in subtle or informal ways; what conditions support or limit this incorporation; and how teachers' framing choices reflect acts of epistemic disobedience. Through this work, we hope to understand how teachers can be supported in leveraging CRP or recognize where they are already doing so as they resist a system that often discourages the kind of teaching their students need.

## III. RESEARCH QUESTION

This study aims to investigate how the teaching of physics is framed within a context dominated by coloniality, towards developing culturally relevant pedagogy in Nigerian classrooms. By framing, I mean the act of shaping how knowledge is presented by highlighting specific aspects of reality that challenge colonial influences. As Osibodu [18] notes, coloniality underscores the ongoing impact of colonial ideologies and power structures in contemporary education. The main research question for the study is: *How do Nigerian high school physics teachers frame the teaching of physics within a curriculum context shaped by colonial legacies?*

## IV. THEORETICAL FRAMEWORK

This study draws on three interrelated theoretical constructs: framing, culturally relevant pedagogy (CRP), and coloniality. These frameworks help explore how Nigerian physics teachers interpret science content, make instructional decisions, and navigate tensions between the demands of the canonical curriculum and the cultural realities of their students.

Framing theory [19,20] is central to this study because it focuses on how individuals interpret "what is going on" in a given situation. For teachers, framing helps explain how they make sense of classroom interactions and decide what to foreground, whether to emphasize abstract content or make space for cultural and practical experiences. For the purpose of this paper, *we define framing as the act of shaping how knowledge is presented by highlighting specific aspects of reality that challenge colonial influences.* Teachers may use framing to reorient lessons toward local meanings, student voices, and real-world applications, subtly resisting Western epistemologies as the default standard of scientific knowledge.

To expand this view, this study draws on Culturally Relevant Pedagogy (CRP) [8] and the concept of coloniality [10, 21]. In this paper, CRP refers to teaching practices that recognize and include students' cultural knowledge, languages, and everyday experiences in physics instruction, making learning more relevant and relatable to their lives [8]. However, these practices often exist in tension with an education system still shaped by coloniality, which privileges Western knowledge systems and continues to frame science as neutral, objective, and superior. As it is noted, coloniality underscores the ongoing impact of colonial ideologies and power structures in contemporary education [18]. It reinforces racial hierarchies in countries like Nigeria by privileging Western frameworks, particularly in the sciences, while perpetuating the perception of non-Western knowledge systems as inferior or irrelevant [18]. This enduring dominance of Western epistemologies continues to shape how education is framed, often sidelining local and indigenous ways of knowing. While CRP provides a valuable lens for understanding culturally responsive teaching, its original development in the U.S. context means that certain adaptations may be necessary to fully capture the specific cultural, historical, and systemic realities of Nigerian classrooms.

## V. METHODS

The participants for this study were teachers with whom the first author had previously worked with during a science teacher professional development workshop organized in Nigeria in 2024. That workshop brought together over 50 teachers, and afterward, we formed a professional learning community (PLC) to continue communicating with each other. For this study, the PLC was used for recruitment of teachers, which made this a case of convenience sampling. For recruitment, a message was sent to the PLC members asking for in-service physics teachers with 5–10 years of experience who would be willing to share their thoughts on how physics should be taught. Nine teachers responded and we had an informal chat with these teachers to see how they incorporate elements of CRP in their teaching. Two teachers were selected for a semi-structured interview, which were conducted via Zoom and transcribed using Otter AI. We asked questions like "*What are your thoughts about a universal approach to how physics is taught? Tell me a time when your physics teaching went well or did not go well in the classroom?.* The pseudonym names for the teachers were Obi and Esther. While nine teachers participated in informal interviews, two were selected for in-depth, semi-structured interviews due to the richness of their responses.

Interview transcripts were analyzed using thematic coding that was done inductively. We analyzed each transcript as a narrative to explain how teachers frame their instruction, explain influences of coloniality, and their use of CRP. The transcripts were read multiple times to stay close to the teachers' stories and language. Two rounds of coding were done: in the first round, open coding was used to identify recurring phrases, images, and ideas; in the second round, the codes were revisited to connect them to broader themes around framing, culturally relevant pedagogy, and coloniality.

## VI. FINDINGS

This section shares what emerged from interviews with two Nigerian physics teachers, whom I refer to as Esther and Obi, to highlight how they navigate their teaching practices within a curriculum that prioritizes universal models of physics education. It captures the ways in which they strive to make physics relevant and culturally meaningful for their students, even when faced with systemic barriers like large classes, colonial legacies, and limited resources. Their reflections offer a window into the creativity, agency, and tensions at play as they strive to bring physics closer to students' lives, demonstrating how teaching is both a personal and a political act in these classrooms.

### A. The Concept of Universal approach in Teaching Physics

While both teachers acknowledge the universality of physics concepts, their perspectives suggest a firm rejection of a one-size-fits-all approach to teaching the subject. Obi, for instance, remarked:

*"In principle, yes, because the concepts of physics are universal. But in practice, no. Students have different needs and challenges depending on where they are. The key is making physics applicable to real life. They should understand it not just to pass exams but to see how it connects to their everyday lives and future professions."*

Similarly, Esther emphasized the importance of hands-on and situated learning, stating:

*"If you're teaching about simple machines, bring those machines into the classroom. If it's an outdoor machine, let the student go outside and explore it. The physics behind it should be explained after they've had that hands-on exposure."*

These reflections show that while Obi and Esther value the universality of physics content, they advocate for a contextualized and culturally responsive pedagogy. They argue that effective teaching must consider students' lived experiences, cultural environments, and socioeconomic realities. Their views challenge the assumption that physics education can be universally standardized, instead emphasizing the need to adapt instruction to local contexts in order to foster meaningful and equitable learning.

### B. Language, its Misconception, and Strength

One of the critical insights from the teacher interviews is the role of language as both a source of misconception and a powerful pedagogical tool for making physics meaningful. Within the context of Nigerian classrooms, where students bring diverse linguistic and cultural resources, Obi and Esther face the dual task of navigating misunderstanding while also honoring these assets. They described how students' everyday use of language, shaped by local dialects, cultural references, and naming practices, can lead to misinterpretations of scientific terms. For example, in a lesson on elasticity, Esther recounted how students referred to plastic buckets as "rubber," leading them to assume that plastics are elastic. *"They'd say, 'Give me that rubber,' even if it's plastic,"* she explained. Rather than rejecting this understanding, Esther used it as a framing opportunity, inviting students to bring materials from their homes to test and compare. This transformed a linguistic misconception into a hands-on investigation, enabling students to construct meaning through embodied experience rather than passive correction.

Similarly, Obi demonstrated how language and cultural expression could be used as a resource. In a lesson on sound waves, he explored harmonics by drawing from students' ethnic backgrounds and musical traditions.

*"You can take two Yoruba men singing the same song, and their voices will still sound different—the tone, texture, and rhythm show harmonics in action. Students learn that harmonics aren't just in guitars (which many have never seen) but also in their own voices and culture, those are instruments too,"*

This reframes indigenous and everyday experiences, not as distractions from science, but as valid and valuable ways of knowing.

These examples illustrate how teachers are not only delivering content but actively reframing the meaning of physics knowledge to bridge canonical science with students' lived realities. They position language not merely as a tool of instruction, but as a bridge between local knowledge and school science, inviting students to see their own voices, languages, and experiences as integral to the learning process.

### C. Student Voice, Experience and Challenges in the Curriculum

Both teachers demonstrated a strong awareness of the importance of incorporating student voices and lived experiences into physics instruction, despite such practices often being limited by structural constraints. Esther shared how students' community knowledge became a springboard for learning when she connected lessons on simple machines to local farming tools, such as the mobile planter;

*"By asking students to calculate mechanical advantage and efficiency based on tools used in their family farms, she created a space where students could see physics operating in their daily lives."*

Similarly, Obi recounted a lesson on renewable energy that emerged from students' frustrations with unreliable electricity in their neighbourhoods. He explained;

*"We used their experiences with electricity problems to drive the lesson... That gave me the idea to have them build a solar inverter system."*

These moments reflect a student-centered approach, where the teacher listens to students' realities and allows those experiences to shape the lesson. However, both teachers also acknowledged that such meaningful engagements are rarely planned into the curriculum and often occur only *"when the experience directly relates to the lesson at hand."* Esther noted that she is required to follow a rigid scheme of work, which limits her ability to expand on students' contributions, while Obi highlighted that time pressures and curriculum pacing often force teachers to focus on covering exam-relevant topics. As a result, although they both recognize the value of integrating student voices and experiences into science learning, these efforts remain occasional and reactive, rather than embedded within the formal structure of physics instruction.

### D. The Task of a large classroom

Both Obi and Esther reveal that culturally responsive teaching in Nigerian physics classrooms requires intentional strategies to engage all students, particularly in contexts of overcrowded classrooms and limited resources. Teacher Obi described how, in classes of up to 90 students, he uses group work as a practical method for inclusion, stating,

> *"Each group has one of the top-performing students as a leader... I make sure to mix students of different performance levels... this way, knowledge is distributed."*

This approach helps create a collaborative mindset where stronger students support others, and struggling learners gain confidence. He added,

> *"I brought them forward, encouraged them despite their fear... I told them, 'I see you. You haven't quite grasped this yet. Let's fix that.'"*

This personal attention, even extended after class, reflects a commitment to relational teaching that values every student's learning journey. Esther, in a similar spirit, emphasized the importance of allowing students to express physics ideas in their own words and linguistic contexts to their peers, stating, *"Sometimes I call on students to interpret a concept in their own words to their peers after I've simplified it."*

While grouping students by performance can support peer learning, it also risks reproducing labels and hierarchies, especially when students internalize being "low performers." In such settings, where teachers have limited capacity to give individual attention, categorization often emerges as a coping strategy, not a sign of deficit thinking. The key challenge, then, is how to help teachers differentiate instruction without stratifying learners. This might involve professional development that equips teachers to recognize diverse forms of student strength, including oral expression, creativity, or effort, not just exam performance. It also calls for rethinking success in more holistic terms and encouraging fluid, rotating leadership roles within groups, so that all students have opportunities to lead, explain, and grow. In large and under-resourced classrooms, culturally relevant teaching is not just about what is taught, but also about how every student is seen, heard, and supported, even when structural limitations persist.

### E. Limitations of Professional Development and Textbooks for Culturally Relevant Teaching

Both Esther and Obi highlighted that while professional development (PD) plays a crucial role in improving physics instruction in Nigeria, it often falls short in preparing teachers to deliver culturally responsive and contextually grounded lessons. Esther emphasized that PD has helped her adopt new instructional strategies and tools, stating,

> *"Through professional development and during my Postgraduate Diploma (PGD), I attended workshops and learned a lot... These sessions changed how I see and teach physics."*

She spoke about improvements in graph plotting, standardized exam grading, and classroom technology, indicating that PD is mainly oriented toward technical competence and curriculum alignment. However, there was no mention of how PD addresses the integration of students' lived experiences, languages, or cultural knowledge into physics instruction. Similarly, Teacher Obi described PD as *"very general, focused on science education as a whole, not specifically on connecting physics to culture."* His comment reflects the systemic absence of culturally relevant frameworks in formal teacher training. The teachers also reflected that textbooks in their current form do not offer structured opportunities for students to explore physics through local, familiar, or everyday examples, making authentic engagement and relevance dependent on the teacher's initiative rather than institutional design. As a result, Obi and Esther must rely on their own instincts, creativity, and personal commitment to bring cultural relevance into their classrooms.

## VII. DISCUSSION AND CONCLUSION

These findings highlight a crucial insight: although Esther and Obi often receive training that prioritizes universal models of physics education, many regardless of experience are finding ways to make the subject culturally relevant and accessible. This ingenuity underscores the agency of Esther and Obi, who are not waiting for curriculum developers or external experts to validate their approaches. Instead, they draw on what they know about their students' lives like local farming practices or musical traditions to reframe physics concepts in ways that resonate and matter. This challenges any deficit narrative that suggests most teachers in Nigeria cannot integrate cultural relevance in their classrooms; instead, it shows Esther and Obi are already doing so, often without formal resources or institutional support.

This study calls for a deeper interrogation of how CRP is understood and implemented in contexts like Nigeria, where historical and structural factors shape classroom dynamics in unique ways. It suggests that while Ladson-Billings' original CRP framework is foundational, it needs to be expanded and adapted to better capture the realities of Nigerian classrooms, particularly how Obi and Esther and potentially other teachers as well navigate large classes, limited resources, and uneven foundational knowledge. The questions become: how can we support teachers in moving beyond deficit thinking while addressing real gaps in student understanding? And how can we reimagine CRP to include context-specific strategies that affirm both teacher and student agency, even within the constraints of systemic and colonial legacies? These questions can guide future research and professional development, offering a more holistic view of how CRP is practiced and can be strengthened in Nigeria and similar contexts.

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