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Advocating for Yorùbá as a medium of instruction in teaching physics

Adeniyi Michael Adeduyigbe *
Science and Technology Education, University of Ibadan, Nigeria

Abstract
Language plays a critical role in physics education, influencing students' comprehension and engagement. This study examines the impact of using Yorùbá as a medium of instruction in teaching physics, highlighting its potential to improve conceptual understanding and academic performance. Drawing from indigenous knowledge systems, the study explores how traditional Yorùbá practices align with fundamental physics concepts. While integrating Yorùbá into physics education presents challenges such as the lack of standardized terminology and teacher preparedness, these can be addressed through curriculum development and bilingual resources. A bilingual approach incorporating Yorùbá and English could enhance learning outcomes, making physics more accessible and culturally relevant.

Keywords
mother-tongue instruction, Yorùbá language, African indigenous knowledge, bilingual education

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Introduction
Indigenous knowledge is a fundamental tool in science education (Omilani, 2024), influencing students' comprehension and engagement, particularly in subjects like physics, where abstract concepts and technical terminology are prevalent (Emeagwali, 2003; Hewson & Ogunniyi, 2011). Many students struggle with physics not necessarily because of the subject's inherent difficulty but due to the cognitive burden of processing scientific content in a second language. In Nigeria, where English is the primary language of instruction, students who are not proficient in it face several learning difficulties and misconceptions in understanding physics concepts such as relativity, electricity, momentum etc.

Several studies have highlighted the benefits of using indigenous languages in STEM education. Countries such as China, Germany, and Finland have successfully implemented mother-tongue instruction not only in early childhood and primary education but also at all levels of education. This approach has led to improved academic performance and a deeper understanding of scientific concepts (Chisholm, 2005; United Nations, 2007). Similarly, research in South Africa has shown that integrating indigenous languages into science education enhances students' comprehension and engagement with complex subjects (Shizha, 2013). These findings suggest that incorporating Yorùbá into physics instruction in Nigeria at all educational levels could create a more inclusive and effective learning environment, promoting cultural relevance.

Physics is deeply embedded in Yorùbá indigenous knowledge systems, with traditional artisans, blacksmiths, and farmers applying fundamental principles of mechanics, heat transfer, and motion in their crafts without formal scientific training (Abiodun, 1998; Tanyanyiwa & Chikwanha, 2011). For instance, Yorùbá architectural designs reflect equilibrium principles, while projectile motion is evident in traditional archery practices (Miyazaki et al., 2013). By integrating these culturally relevant examples into physics education, students can relate scientific theories to their lived experiences, fostering deeper interest and retention (Mawere, 2014). This study therefore examines the impact of language on physics learning, exploring the feasibility of Yorùbá-based instruction and the challenges it presents. It argues that a bilingual approach, where Yorùbá is used alongside English, could reduce cognitive barriers and improve students' conceptual grasp of physics, ultimately contributing to better learning outcomes and a more culturally responsive education system (Newman, 2008; United Nations, 2007).

The Role of Language in Teaching Physics
Language plays a crucial role in science education, especially in physics, known as físíkìsì in Yorùbá. Teaching and learning physics involve complex abstract concepts, mathematical expressions, and specialized terminology that can be challenging for students to understand when they are taught in a language that is not their first language (Emeagwali, 2003; Hewson & Ogunniyi, 2011). Many students struggle with physics not because the subject itself is inherently difficult, but due to the additional cognitive load of processing scientific content in a second language. Most of these students are not proficient in English, which raises the question: how can they grasp the concepts if they are taught using the same language? Concepts such as relativity, electricity, the equilibrium of forces, momentum, and inertia are often hard for students to grasp when taught in English, as the terminology doesn't relate directly to their everyday experiences. Translating these concepts into Yorùbá can enhance understanding by connecting abstract scientific principles to real-life applications (Mawere, 2014).

Countries that have successfully integrated indigenous languages into STEM education have reported higher student engagement and improved retention rates (Chisholm, 2005; United Nations, 2007). In nations like China, Germany, and Finland, students are taught science in their mother tongue, which has led to better conceptual understanding and academic performance. A recent experience reinforced this idea for me. While travelling on the Ibadan-Lagos train, I observed that the Chinese staff managing the operations communicated seamlessly in their native

* Corresponding author
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language, despite not speaking English. This ability to think, work, and innovate in their language is undoubtedly contributing to their advancement in science and technology. Learning difficult physics concepts in one's native language makes them more accessible. When students are taught using words and expressions familiar to their cognitive framework, rather than foreign terminology or English, comprehension becomes easier. In South Africa, where some institutions have incorporated indigenous languages into science education, students have demonstrated an improved understanding of physics concepts (Shizha, 2013). This suggests that integrating Yorùbá into physics instruction in Nigeria could enhance learning outcomes, reducing the cognitive burden students face when translating complex scientific ideas into an unfamiliar language (Newman, 2008).

Physics is already deeply embedded in Yorùbá indigenous knowledge systems. Traditional artisans, blacksmiths, and farmers have applied fundamental physics principles for centuries without formal classroom instruction (Abiodun, 1998; Tanyanyiwa & Chikwanha, 2011). The concept of ìṣọ̀kan ìwọ̀n (equilibrium) is evident in Yorùbá architectural designs and indigenous construction techniques, which rely on balance and force distribution. Similarly, Ìṣípòpadà Ìṣẹ́kọ̀ (projectile motion) can be observed in Yorùbá traditional archery, where ofà (bows and arrows) and ọ̀bẹ̀ (throwing knives) are used with precise control of force and trajectory (Miyazaki et al., 2013). Furthermore, the principles of agbára ìmuná (heat energy) and thermal expansion are demonstrated in Yorùbá iron-smelting and blacksmithing processes. Even Yorùbá musical instruments, such as the gángan (talking drum) and bàtá, operate based on the physics of sound waves and resonance (Nyota & Mapara, 2008). By incorporating these culturally relevant examples into physics instruction, students can relate scientific theories to their everyday experiences, promoting deeper engagement and a stronger interest in the subject (Mawere, 2014).

Opportunities and Challenges of Teaching Physics in Yorùbá

While the benefits of teaching physics in Yorùbá are evident, implementing this approach presents both opportunities and challenges. One major advantage of integrating Yorùbá into physics concepts is the potential to improve conceptual understanding. Teaching physics in Yorùbá allows students to connect scientific concepts to their everyday experiences, making abstract theories more relatable (Shizha, 2007). Many students struggle with physics not because they lack intelligence or effort, but because they cannot easily relate technical scientific vocabulary to familiar situations. Yorùbá-based instruction provides a linguistic bridge that enables deeper comprehension of scientific ideas (Ngara, 2007).

One significant benefit of integrating indigenous languages into education is the potential for increased student engagement and retention. Students who learn in a language they are comfortable with are more likely to actively participate in discussions, ask questions, and develop a lasting interest in subjects like physics. For example, during my primary and secondary school days, my teachers often limited our discussions by insisting that we speak only in English. This meant that if we struggled to express ourselves in English, we would remain silent, which did not indicate our understanding of the concepts being taught. Research on bilingual education models indicates that students who learn in both indigenous and global languages tend to perform better than their peers in monolingual education systems (Ginsburg & Golbeck, 2004). Therefore, we should not restrict the integration of Indigenous languages to early childhood and primary education; we should extend this approach to all levels of education, as is practiced in some other countries. Gradually incorporating Yorùbá into physics instruction could boost academic performance while also preserving our linguistic and cultural heritage, leading to greater cultural relevance and inclusion (Shizha, 2013).

Despite these benefits, the implementation of Yorùbá-language physics instruction presents some significant challenges. One of the major concerns is the lack of standardized Yorùbá scientific vocabulary. Many physics terms do not have direct Yorùbá translations, which could make instruction difficult (Hewson & Ogunniyi, 2011). However, this challenge can be addressed by developing bilingual science glossaries that provide standardized translations of physics concepts (Mkabela, 2005). Countries like South Africa and Ethiopia have successfully developed similar resources for their indigenous languages, proving that this approach is feasible and effective (Chisholm, 2005).

Another barrier to effective education is teacher preparedness. Many physics teachers in Nigeria were trained in English and may lack the proficiency or confidence to teach physics in Yorùbá. This issue can be addressed by introducing teacher training programs that equip educators with both linguistic and pedagogical skills to effectively deliver physics lessons in Yorùbá (Clark, 1997). These programs should include curriculum revisions, professional development workshops, and instructional materials designed to support bilingual science teaching (Mapara, 2009). Resistance from parents and policymakers poses another challenge. Many parents believe that English-language instruction is crucial for global competitiveness and may be reluctant to support Yorùbá-based physics education. When parents are expected to communicate in Yorùbá with their children, they often default to English, which can lead to a lack of connection with the language and contribute to the perception that Yorùbá is not beneficial. However, research has shown that bilingual education models do not hinder English proficiency; rather, they enhance cognitive flexibility and problem-solving skills (Mawere, 2014). A well-structured bilingual approach, where Yorùbá is used alongside English, could help alleviate these concerns while ensuring that students reap the benefits of learning physics in their mother tongue (United Nations, 2007).

The lack of instructional materials in Yorùbá also poses a significant challenge. Currently, most physics textbooks, lab manuals, and digital learning resources are only available in English. To successfully implement Yorùbá-based physics instruction, there must be a collaboration between educators, linguists, and curriculum developers to create Yorùbá-language physics textbooks, interactive learning materials, and digital resources (Agwuele & Bodomo, 2018, p. 464). Open Educational Resources (OER) and AI-powered translation tools can also accelerate the development of these materials, making Yorùbá-based physics instruction more accessible and effective for learners.

Despite these challenges, the successful implementation of indigenous language education in STEM subjects across various African and global contexts proves that teaching physics in Yorùbá is both feasible and beneficial. By gradually introducing Yorùbá into physics instruction, Nigeria can create a more inclusive and effective science education system that enhances student engagement, improves comprehension, and fosters greater interest in physics (Shizha, 2013; United Nations, 2007).

Conclusion

Language plays a crucial role in shaping students' understanding of physics, influencing both their engagement and comprehension. Teaching physics in Yorùbá can make abstract concepts more relatable by connecting them to students' everyday experiences. While challenges such as the lack of standardized scientific terminology and teacher preparedness exist, they can be addressed through curriculum development and teacher training. A bilingual approach that integrates Yorùbá with English has the potential to improve learning outcomes, foster deeper conceptual understanding, and create a more inclusive and effective science education system.

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