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Integrating Indigenous Knowledge into Chadian Primary Science: A Phenomenological Inquiry with Teachers

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Abstract

This qualitative phenomenological study investigates the perspectives of primary school teachers in Chad on integrating Indigenous Knowledge (IK) into the science curriculum. Based on in-depth interviews with 25 teachers, the analysis revealed three key themes. First, while teachers universally acknowledged IK's pedagogical value for enhancing student engagement and comprehension, their own understanding of IK remained superficial and anecdotal. Second, a significant professional development gap was evident, with teachers reporting no training in ethnoscience or culturally responsive methods, leading to low confidence in integration. Third, formidable systemic barriers were identified, including a rigid, overloaded national curriculum, high-stakes examinations, and severe resource constraints, which collectively stifle pedagogical innovation. The findings reveal a critical misalignment between teachers' supportive aspirations for IK and the systemic realities that constrain implementation. The study concludes that sustainable integration requires a multi-pronged approach involving curriculum reform to allow local contextualization, comprehensive teacher professional development in culturally sustaining pedagogies, and the provision of context-specific teaching resources. By centering teacher voices, this research contributes directly to policy discussions on educational reform in Chad and offers critical insights for the broader discourse on decolonizing science education in Africa.

Keywords: Indigenous Knowledge; Science Education; Curriculum Integration; Teacher Perspective; Phenomenological Study; Culturally Responsive Pedagogy; Educational Reform; Chad.

1. INTRODUCTION

The contemporary global educational landscape is characterized by a pressing tension between globalization and localization. While there is an undeniable drive for curricula that produce globally competitive graduates, a powerful counter-narrative advocates for education that is locally relevant and culturally sustaining (Ladson-Billings, 2014; Smith, 2019). This paradigm, often termed culturally responsive pedagogy, posits that meaningful learning occurs when students' cultural identities, languages, and prior knowledge are recognized as assets within the classroom. Nowhere is this tension more acute than in Sub-Saharan Africa, where the enduring legacy of colonial education systems has often resulted in curricula that are profoundly disconnected from the lived experiences, linguistic repertoires, and epistemological frameworks of African learners (Shizha, 2013; Abdi, 2021). This epistemic disconnect is particularly stark in science education, where Western scientific paradigms are frequently presented not as one way of knowing, but as the sole authoritative and universal system, thereby systematically marginalizing the rich, place-based, and empirically derived Indigenous Knowledge (IK) systems that have sustained communities for millennia (Ogunniyi, 2019).

In nations like the Republic of Chad, a linguistically and culturally diverse Sahelian country, this disconnect is not merely an academic concern but a critical factor undermining educational efficacy. Chad's educational system, which continues to operate on a centralized, Francophone-inspired model, grapples with a triad of formidable challenges: access, quality, and relevance (World Bank, 2021). The lack of curricular relevance is increasingly identified as a key contributor to persistently low student engagement, high dropout rates, and poor learning outcomes, effectively stymying national development efforts and investments in the education sector (UNDP, 2022). Within this context, the potential integration of Chad's vast repository of IK—encompassing sophisticated understanding of local ecology, sustainable agriculture in the Logone floodplains, Sahelian meteorology, and traditional medicine—is a strategic imperative. Making science education resonate with the socio-cultural realities of Chadian students is essential for improving educational outcomes.

The theoretical and empirical case for integrating IK into science curricula is robust and well-articulated in the literature. Scholars have convincingly framed this integration as a fundamental step towards decolonizing education and affirming the cognitive sovereignty of Indigenous peoples (Odora-Hoppers, 2002; Chilisa, 2020). From a pedagogical standpoint, this approach aligns strongly with constructivist and sociocultural theories, which posit that learning is profoundly enhanced by building bridges between new academic concepts and learners' pre-existing cognitive structures and cultural funds of knowledge (Vygotsky, 1978; Mbati, 2020). Empirical studies from various African contexts, including Nigeria, Kenya, and South Africa, have demonstrated that the thoughtful incorporation of local knowledge can significantly enhance student interest, conceptual understanding, and academic achievement in science subjects (Eze, 2019; Keane, 2017; Onowu & Olorundare, 2022).

Despite this compelling international evidence and theoretical foundation, the practical pathway to

implementing such integration remains obscure within the specific context of Chad. The success of any curriculum reform hinges ultimately on teachers, who act as the final arbiters and interpreters of the curriculum in their classrooms (Borg, 2015; Fullan, 2016). Their perceptions, pedagogical content knowledge, and agency are the linchpins of sustainable change. However, the existing body of literature on education in Chad is predominantly macro-level, focusing on issues of infrastructure, funding, and gross enrollment rates (UNICEF, 2020; World Bank, 2021). A critical void exists in ground-level, empirical research that investigates the key agents of change—the teachers. Presently, there is no known study that systematically explores the capacity, attitudes, and perceived challenges of Chadian primary school teachers regarding the integration of IK into the science curriculum. Without a deep understanding of this crucial practitioner perspective, any policy initiative aimed at curricular transformation is likely to be misinformed and unsustainable.

To address this identified gap, this study is guided by the following research questions:

a) What are the perceptions of primary school teachers in Chad regarding the value of integrating Indigenous Knowledge into the science curriculum?
b) How prepared do these teachers feel to undertake such integration?
c) What systemic and contextual barriers do they identify in implementing a culturally relevant science curriculum?

By centering the voices of teachers, this research aims to provide evidence-based insights that can inform effective teacher professional development and context-sensitive curriculum policy in Chad, thereby contributing to the broader goal of creating a more relevant, equitable, and effective education system.

2. LITERATURE REVIEW

The call for integrating IK into science education is rooted in the critique of the hegemony of Western science and the movement towards decolonizing education (Odora-Hoppers, 2002). Scholars argue that such integration can foster bicultural or multicultural science literacy, allowing students to navigate both their local and global worlds (Aikenhead & Jegede, 1999). Studies across Africa have demonstrated positive outcomes. In Nigeria, research showed that using cultural examples in teaching physics improved student performance (Eze, 2019). In South Africa, the inclusion of IK in the national curriculum policy, despite implementation challenges, signifies a political commitment to redress historical epistemic injustices (Department of Basic Education, 2011). The role of the teacher is paramount. Successful integration requires teachers to be not merely transmitters of knowledge but also cultural brokers and curriculum co-developers (Semali & Mehta, 2012). However, teachers often lack the necessary training. Studies in Botswana and Kenya found that while teachers held positive attitudes towards IK, they felt inadequately prepared to teach it, citing a lack of resources and guidance from the national curriculum (Shumba, 2011; Keane, 2017). In the Chadian context, literature on education is sparse and often focuses on macro-level issues like infrastructure, funding, and enrollment (UNICEF, 2020). There is a significant

gap regarding pedagogical content and teacher agency. This study aims to contribute to filling this void by providing a ground-level perspective on curriculum reform.

3. METHOD

3.1. Research Design

This study employed a qualitative phenomenological approach to deeply understand the lived experiences and perceptions of primary school teachers regarding the integration of IK (Creswell & Poth, 2018).

3.2. Participants and Setting

A purposive sampling technique was used to select 25 primary school science teachers. The sample included 12 teachers from urban schools in N'Djamena and 13 from rural schools in the Mayo-Kebbi Est region to capture diverse perspectives. Participants' teaching experience ranged from 3 to 20 years.

3.3. Data Collection

Data were collected through semi-structured interviews conducted in French or a local language (with the aid of a translator). Each interview, lasting 45-60 minutes, was audio-recorded and transcribed. The interview protocol explored: (a) teachers' understanding of local IK, (b) their views on its relevance to science topics, (c) their previous attempts at integration, (d) perceived barriers, and (e) suggestions for support.

3.4. Data Analysis

Transcribed data were analyzed using Braun and Clarke's (2006) thematic analysis. This involved familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. To ensure trustworthiness, peer debriefing and member checking were employed.

4. RESULT AND DISCUSSION

4.1. Research Result

The analysis of interview data yielded three major themes that capture the complexities of integrating Indigenous Knowledge (IK) into science education from the perspective of Chadian primary school teachers.

4.2.1. Theme 1: Acknowledged Pedagogical Value Contrasted with a Superficial Understanding

All 25 participants unanimously affirmed the potential value of integrating IK into science lessons, primarily citing its power to enhance student engagement and comprehension. Teachers observed that using local examples created an immediate "bridge of understanding" for students. A teacher from a rural

community in Bongor illustrated this point:

> *"When I explain plant growth and germination, I don't start with the diagram in the book. I start by asking them how their parents know the soil is ready for planting millet. They say, 'When the Sclerocarya birrea (Marula) tree starts to flower.' From there, we can talk about soil temperature, rainfall, and seasons. The concept becomes real, not just a picture." (Participant 07, Rural, 8 years of experience)*

Another teacher from Mongo highlighted its utility in teaching animal adaptation:

> *"To explain camouflage, we look at the Fennec fox and the scimitar-horned oryx. Children here have seen these animals; they know how their colors blend with the desert. This is more powerful than showing them a picture of a chameleon from a different continent." (Participant 14, Rural, 12 years of experience)*

However, this recognition of pedagogical value existed in stark contrast to the teachers' own depth of understanding. For most, particularly the 12 teachers from N'Djamena, their knowledge of IK was fragmented and anecdotal, often described in folkloric or cultural terms rather than as a coherent knowledge system. They struggled to deconstruct the local practices into underlying scientific principles. For instance, while many knew that certain plants were used in traditional medicine, they could not explain the potential biological or chemical mechanisms, viewing it as "traditional belief" rather than empirically-derived knowledge. One urban teacher admitted:

> *"We know the Moringa tree is used for purification and nutrition, but I would not know how to connect it to a lesson on water purification or nutrients in a way that meets the curriculum objectives. My knowledge is too general." (Participant 03, Urban, 5 years of experience)*

This superficial understanding created a significant barrier to systematic integration, limiting its use to occasional, illustrative anecdotes rather than a foundational pedagogical approach.

4.2.2. Theme 2: The Professional Development Gap: A Consensus on Inadequate Preparedness

An overwhelming majority of teachers (22 out of 25) expressed a profound sense of unpreparedness to integrate IK into their science teaching. This sentiment was uniformly linked to a complete absence of training in either pre-service teacher colleges or in-service professional development. Participants reported that their pedagogical training was overwhelmingly centered on transmitting the official, Francophone curriculum.

A teacher from N'Djamena encapsulated the frustration of many:

> *"From the teachers' college, we were drilled to follow the textbook page by page. Our lesson plans are inspected for compliance. We don't have the tools, the methods, or the confidence to bring in outside knowledge, even if it's from our own heritage. We were never taught how to do it." (Participant 01, Urban, 10 years of experience)*

This lack of preparedness manifested as a lack of confidence. Teachers feared that introducing local knowledge might be perceived as "unscientific" or could lead to them providing "incorrect" information that would conflict with examination standards. The data revealed a clear and unanimous demand for structured support. Participants specifically called for:

- Practical, hands-on in-service workshops led by cultural knowledge holders (elders) and science educators.
- A curated guidebook or supplementary materials that explicitly link specific units in the national science curriculum (e.g., "Ecosystems," "Properties of Matter") with relevant Chadian IK.
- Demonstration lessons showing effective integration strategies.

> *"If the Ministry could provide us with a simple booklet that says, 'For this chapter, you can use this local example and here is the scientific explanation,' it would change everything. We need authorization and guidance." (Participant 11, Rural, 15 years of experience)*

4.2.3. Theme 3: Systemic Barriers: The Tyranny of Curriculum, Assessment, and Resource Scarcity

Beyond individual capacity, teachers identified formidable systemic barriers that actively discourage the integration of IK. The national curriculum was consistently described as the primary obstacle. Teachers used terms like "overloaded," "inflexible," and "rigid" to characterize it, noting that its prescriptive and dense nature leaves no time for pedagogical experimentation or local contextualization.

The pressure of high-stakes examinations further cemented this constraint. Student progression and teacher performance are often judged by results on standardized tests that are exclusively based on the national syllabus.

> *"My priority is to cover all the topics before the exams. The inspectors and the parents care about the results. If I spend time on stories about local plants, I am seen as wasting time and jeopardizing the children's future." (Participant 05, Urban, 7 years of experience)*

Compounding these curriculum and assessment pressures were severe resource constraints. Overcrowded classrooms, with student numbers often exceeding 60, were reported as the norm, making interactive or discussion-based pedagogies nearly impossible. A critical lack of basic teaching aids (lab equipment, posters, libraries) was also a universal complaint.

An urban-rural divide was evident within this theme. Rural teachers (13 participants), while possessing richer and more immediate access to IK sources and community elders, faced the most acute material shortages, often lacking even textbooks and electricity. In contrast, urban teachers had marginally better access to some resources (e.g., photocopiers, occasional internet) but reported a greater sense of alienation from the local knowledge base and stronger pressure to adhere strictly to the centralized curriculum. As one rural teacher poignantly stated:

> *"Here, the knowledge is all around us, but we have nothing to teach with. In the city, they have more tools, but they have lost touch with what to use them for." (Participant 19, Rural, 20 years of experience)*

4.2. Discussion

This study provides a ground-level analysis of the opportunities and formidable challenges inherent in integrating Indigenous Knowledge (IK) into science education in Chad, as perceived by primary school teachers. The findings paint a consistent picture: while teachers are overwhelmingly supportive of the pedagogical value of IK, their ability to act on this belief is critically constrained by a triad of systemic failures—in curriculum design, teacher preparation, and resource allocation.

The strong consensus on the value of IK for enhancing student engagement and comprehension aligns with a growing body of research from across Africa, which positions local knowledge as a vital bridge to formal science concepts (Keane, 2017; Onowu & Olorundare, 2022). However, our findings extend this literature by highlighting the acute nature of these challenges within Chad's specific context. The "pedagogical value vs. superficial understanding" paradox identified in Theme 1 is particularly revealing. It suggests that while teachers are aware of IK as a motivational tool, they largely perceive it as a collection of discrete anecdotes rather than a coherent, valid knowledge system that can be systematically analyzed and taught. This aligns with Mbati's (2020) observation that without deep epistemological understanding, IK integration risks being tokenistic, failing to achieve the deeper goal of fostering bicultural science literacy as envisioned by Aikenhead and Jegede (1999).

The tension teachers described between the prescribed national curriculum and local knowledge embodies a fundamental conflict in educational foundations: the clash between a "standardized" model of education, designed for uniformity and global benchmarking, and a "situated" model, which prioritizes local relevance and cultural sustenance (Smith, 2019). The Chadian teachers' predicament, where they feel

powerless to deviate from the centralized syllabus, is a direct consequence of a system that privileges bureaucratic control over professional autonomy. This finding powerfully underscores the enduring relevance of Schwab's (1973) critique of purely "theoretical" curricula and his advocacy for the "practical," a mode of curriculum deliberation that is eclectic, context-dependent, and involves teachers as key participants. The current system in Chad, as reported by our participants, excludes them from this deliberative process, positioning them as mere implementers of a top-down mandate. This explains why the perceived "inflexibility" of the curriculum and the pressure of high-stakes examinations (Theme 3) were cited as the most significant barriers, effectively stifling pedagogical innovation.

Furthermore, the near-universal lack of teacher preparedness identified in Theme 2 points to a critical gap in both pre-service and in-service teacher education in Chad. The reported absence of training in ethnoscience, culturally responsive pedagogy, or community engagement indicates that teacher preparation programs remain anchored in a colonial paradigm that devalues local knowledge (Abdi, 2021). This creates a cycle of disempowerment: teachers are trained to deliver a decontextualized curriculum and are then held accountable for results that this same curriculum makes difficult to achieve. To break this cycle, teacher education must be radically reoriented. It must move beyond its current focus on content delivery and generic methods to include core modules on local ethnography, the philosophy of Indigenous Knowledge systems, and the principles of culturally sustaining pedagogies (Paris & Alim, 2017). This would equip teachers with the conceptual tools and the professional confidence to become cultural brokers and curriculum co-developers, rather than passive technicians.

In essence, the findings suggest that the challenge of integrating IK in Chad is not primarily a question of teacher willingness, but one of systemic alignment. The teachers' expressed need for guided workshops and curated resources is a plea for a supported transition. It indicates that sustainable integration requires a synchronized reform at multiple levels: a more flexible national curriculum that allows for local contextualization, a transformation of teacher professional development, and the provision of context-specific teaching and learning materials. Without this multi-pronged approach, the rich IK of Chad will remain an untapped resource, and the goal of a truly relevant and effective science education will remain elusive.

4. CONCLUSION

This study concludes that while Chadian primary school teachers universally recognize the profound pedagogical value of Indigenous Knowledge (IK) in making science education more relatable and effective for their students, this potential remains critically unrealized due to a complex interplay of individual, institutional, and systemic barriers. The findings reveal a telling paradox: teachers acknowledge IK's power as a "bridge of understanding," yet their own superficial, often folkloric grasp of these knowledge systems prevents its systematic integration, reducing it to occasional anecdotes rather than a foundational pedagogical approach. This gap in deep epistemological understanding is directly attributable to a critical

failure in teacher professional development, where pre-service and in-service training completely overlook ethnoscience and culturally responsive methodologies, leaving educators without the confidence or tools to navigate beyond the prescribed Francophone curriculum.

Compounding this lack of preparedness, teachers find themselves constrained by a rigid, overloaded national curriculum and a high-stakes examination system that collectively prioritize bureaucratic compliance over professional autonomy and contextual relevance. The pervasive lack of basic resources and overcrowded classrooms further stifles any potential for the interactive, discussion-based teaching that IK integration necessitates, creating a disempowering cycle where teachers are held accountable for results that the system itself makes difficult to achieve. Therefore, the challenge is not one of teacher willingness but of systemic alignment; sustainable integration requires a synchronized, multi-pronged reform. This entails a decisive shift in curriculum policy to allow for local contextualization, a radical transformation of teacher education to include culturally sustaining pedagogies, and the strategic development of supportive resources like practical guidebooks. Ultimately, empowering Chadian teachers as cultural brokers and curriculum co-developers, rather than mere implementers of a top-down mandate, is the essential pathway to transforming science education into a truly relevant, equitable, and effective endeavor that honors Chad's rich indigenous heritage.

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