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Re-situating School Mathematics in Local Histories of Practice: Integrating Indigenous Knowledge Systems in Zambia

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Research Article

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Abstract

This study examines how Indigenous Knowledge Systems (IKS) can be integrated into Zambian mathematics classrooms through an Afrocentric, decolonial lens. Using a convergent parallel mixed-methods design, we combined teacher surveys (n = 55) with semi-structured interviews (n = 15) across rural and urban schools in Southern Province. Four intersecting themes emerged curriculum rigidity, cultural dissonance, teacher uncertainty, and pedagogical resilience. Teachers reported a persistent disconnect between learners' lived experiences and abstract, Eurocentric syllabi, yet many exercised professional agencies to embed local practices in instruction. We illustrate three history-connected, classroom-ready resources: (i) basket-weaving symmetries for plane isometries and tessellations; (ii) indigenous land-measurement units and pacing/rope methods for estimation, ratio, and unit conversion; and (iii) market arithmetic for proportional reasoning and mental computation. Building on these vignettes, we propose a four-pillar framework for implementation: decolonized curriculum reform, culturally responsive teacher education, community knowledge collaboration (with elders/artisans), and learner identity engagement. The findings position IKS as academically rigorous and central to equity, while offering historically grounded materials that instructors can adopt immediately. We argue that integrating IKS re-situates school mathematics within local histories of practice, advancing instruction that is culturally affirming, socially just, and pedagogically powerful.

Introduction

Across the world, both in the Global North and the Global South, researchers continue to express concern about how learners participate in and identify with mathematics. Although the underlying causes differ across contexts, the question of belonging and engagement remains a recurring theme. In the United States and Europe, studies indicate that cultural disconnections and narrowly defined curricula can diminish students' confidence and sense of inclusion in mathematics classrooms (Nasir & Royston, 2013; Powell, Brantlinger, & Romero, 2023; Garcia-Olp, Nelson, & Saiz, 2022). In Zambia, similar challenges are compounded by postcolonial legacies and language policies that influence how learners experience mathematics in school (Kadonsi, Muzata, & Simalalo, 2023). This article therefore explores how placing local knowledge and learner identities at the center of mathematics education can offer a more meaningful understanding of engagement, rather than assuming a universal decline in students' interest or participation.

To decolonize education is to go beyond cosmetic curriculum changes; it is to fundamentally challenge and transform the colonial structures embedded in our educational systems. It involves creating space for diverse ways of knowing, including the deep, place-based knowledge systems that indigenous communities have cultivated over generations. In this context, Indigenous Knowledge Systems (IKS) refer to the rich, contextualized bodies of knowledge that integrate ecological, mathematical, social, and spiritual insights rooted in local cultures. Culturally responsive pedagogy, in turn, is a teaching philosophy that honours and integrates students' cultural identities into the learning process, promoting equity, inclusion, and deeper academic engagement.

Globally, there is growing momentum toward embedding IKS within STEM education. Yet in Southern Africa—and Zambia in particular there remains a critical gap in both research and practice on how mathematics education can be reimagined through indigenous perspectives. While recent studies have begun to examine Zambian teachers' openness to indigenized pedagogies (Kadonsi et al., 2023), what is missing is a coherent framework to guide the integration of IKS into classroom instruction and curriculum design.

This article seeks to respond to that gap by asking:

1. How has the marginalization of IKS impacted mathematics education outcomes in Zambia?
2. In what ways can culturally responsive pedagogy foster inclusive and meaningful mathematics teaching practices?
3. What strategies and frameworks can effectively support the integration of IKS into Zambia's mathematics curriculum?

By addressing these guiding questions, this paper contributes to ongoing conversations on decolonizing education in Africa. It offers a conceptual framework for integrating IKS into mathematics pedagogy and calls on educators, curriculum developers, and policymakers to rethink how mathematics can be taught—not as a foreign import, but as a discipline enriched by local wisdom, cultural relevance, and epistemic justice.

Theoretical Lens and Study Framework.

This article is grounded in the Afrocentric theoretical framework, which offers a critical lens for understanding and transforming mathematics education in postcolonial African contexts. Afrocentricity asserts that knowledge systems and cultural perspectives should be centered on the lived experiences, histories, and contributions of African peoples. Within the context of education—and mathematics education in particular this perspective challenges the dominance of Eurocentric curricular structures and calls for a repositioning of Indigenous Knowledge Systems (IKS) as central to the learning process (Chawane, 2016; Ringstaff, 2023).

The Afrocentric approach emphasizes that meaningful education must reflect the cultural identities of learners. In mathematics classrooms, this means moving beyond abstract, decontextualized content toward instruction that incorporates culturally familiar contexts, symbols, and problem-solving strategies. When mathematical concepts are taught through examples rooted in students' local experiences, learning becomes more relevant and transformative. Such culturally aligned teaching fosters engagement, deepens understanding, and affirms students' identities as capable mathematical thinkers (Kadonsi et al., 2023; Ringstaff, 2023).

Afrocentricity further critiques the universalist assumptions embedded in traditional mathematics curricula, which often ignore African ways of knowing. In response, this framework calls for the inclusion of African heritage, philosophies, oral traditions, and epistemologies in both content and pedagogy. For

instance, Utami et al. (2021) demonstrated that incorporating indigenous artifacts into mathematics lesson planning enhances pre-service teachers' cultural awareness and fosters sustainable, contextually meaningful education. By connecting mathematics to local cultural resources, educators can foster a curriculum that is not only more engaging but also more just.

In addition to curriculum content, the Afrocentric framework highlights the psychological and sociocultural dimensions of learning. A strong sense of cultural identity and belonging is fundamental to academic success. Studies have shown that students who are exposed to Afrocentric content tend to exhibit a more positive self-concept, greater confidence in their academic abilities, and resilience in the face of systemic inequities (Shockley, 2011; Williams & Chung, 2013; Diemer et al., 2016). Thus, Afrocentric pedagogy is both academically and socially empowering.

Furthermore, the integration of Indigenous Knowledge Systems (IKS) through an Afrocentric lens offers a powerful opportunity to rethink and reshape how mathematics is taught and experienced in Zambian classrooms. This approach urges educators to look beyond traditional textbooks and formal theories—to value the knowledge embedded in daily life: the way farmers measure land, how artisans use symmetry in crafts, or how traders estimate and negotiate in markets. These are not just cultural practices they are mathematical in nature, and they carry deep educational potential. Recognizing and drawing from these practices allows learners to see themselves and their communities reflected in the curriculum, which not only enhances understanding but also nurtures pride and belonging (Utami et al., 2021; Diemer et al., 2016).

To help guide this reimagining of mathematics education, this study is built upon a conceptual framework (see Figure 1) that rests on four interconnected ideas—each one reinforcing the others in pursuit of a more inclusive, relevant, and affirming educational experience.

Figure 1: Theoretical Lens and Study Framework.

Note. This framework was conceptualized and developed by the author(s) for the present study. It synthesizes key principles from Afrocentric and decolonial theoretical traditions with empirical insights emerging from the research. The framework is original to this article and has not been published or adapted from any prior work.

At the heart of the framework is the decolonization of mathematics education. This involves questioning and dismantling the colonial legacies that still shape what is taught and how it is taught in many classrooms. It calls on us to move away from one-size-fits-all, imported curricula and instead centre learning around local contexts, languages, and knowledge systems that are meaningful to students.

Closely linked to this is the integration of Indigenous Knowledge Systems recognizing that the wisdom passed down through generations in Zambian communities is not only rich in cultural value but also holds significant mathematical insight. Whether it’s traditional counting systems, spatial design in

basket weaving, or logical reasoning in folktales, these practices provide authentic entry points for learning mathematical ideas in ways that are intuitive and relevant.

To make this integration effective, the framework embraces culturally responsive pedagogy. This is about teaching in ways that connect with who students are honouring their cultural identities, experiences, and ways of learning. It means using local examples, encouraging storytelling, welcoming mother tongue explanations, and building a classroom environment where all students feel seen and heard.

The final thread in this framework is the focus on learner identity and academic engagement. When students feel that their culture is respected and included in their education, they are more likely to develop confidence in their abilities, participate actively, and take ownership of their learning. Positive identity formation is especially important in subjects like mathematics, where many learners may have been made to feel that they do not belong.

Together, these four ideas work hand-in-hand to support a more human, connected, and empowering vision of mathematics education. They challenge us to rethink what we teach, how we teach it, and perhaps most importantly *who* we are teaching. In summary, by grounding this study in the Afrocentric theoretical framework, the article positions itself within a growing body of scholarship advocating for culturally relevant, identity-affirming, and socially just mathematics education. This framework not only aligns with the broader aims of decolonized pedagogy but also offers a transformative pathway for enhancing mathematics teaching and learning in Zambia and across Africa. It is through such culturally responsive approaches that educators can inspire deeper learning, critical thinking, and a renewed sense of purpose among African learners.

Background and Related Scholarship

Global Perspectives on Decolonizing Mathematics Education

In recent decades, a powerful shift has been underway in the global discourse surrounding mathematics education. Increasingly, scholars, educators, and communities are recognizing that mathematics—long portrayed as objective, culture-free, and universal—is deeply embedded in social, cultural, and historical contexts. The traditional framing of mathematics as a neutral discipline has come under scrutiny, particularly in educational settings that serve students from non-Western and Indigenous backgrounds. This critique reveals how Western-centric epistemologies have been privileged in curricula around the world, often at the expense of local knowledge systems and culturally grounded approaches to teaching and learning (Powell, 2022; Bateiha & Mir, 2023).

The idea that mathematics is a “universal language” has been both enduring and persuasive. On the surface, it suggests equality, accessibility, and objectivity. However, this notion also masks the reality

that mathematical knowledge—as it is taught in most formal education systems—has been historically shaped by specific cultural narratives, often rooted in European traditions of logic, abstraction, and measurement (Powell et al., 2023). By ignoring this cultural framing, curricula can inadvertently marginalize students whose ways of knowing, learning, and expressing mathematical ideas differ from the dominant model.

Emerging from this critique is a growing global movement to decolonize mathematics education. This movement is not merely about adjusting lesson plans or including a few culturally diverse examples. Rather, it calls for a fundamental rethinking of what counts as mathematical knowledge, who decides that, and how it should be taught. Central to this effort is the recognition and integration of Indigenous Knowledge Systems (IKS)—not as add-ons, but as valid, complex, and rigorous ways of understanding the world (Ali, 2021; Meaney et al., 2021).

Indigenous mathematical knowledge often emerges from lived experience: counting through storytelling, estimating through trade, measuring land based on environmental cues, or understanding geometry through the design of local crafts. These practices are not inferior or less logical than their Western counterparts; they are simply different in form, context, and purpose. Incorporating IKS into the mathematics curriculum affirms this difference and positions it as a strength. It reframes mathematics as a multicultural human endeavor, rather than a monolithic set of rules to be memorized. This decolonial approach is also inseparable from the pursuit of educational justice. When students see their cultures, languages, and worldviews reflected in what they are learning, they are more likely to feel seen, respected, and empowered. For historically marginalized learners—especially those in Indigenous and African contexts—this kind of representation in mathematics classrooms can have a profound effect. It not only improves engagement and performance but also challenges deep-seated narratives about who is “naturally” good at math and who belongs in STEM fields.

Ultimately, the integration of IKS into mathematics education does more than diversify content—it reshapes the goals and values of teaching itself. It shifts the emphasis from rote memorization and abstract procedures to relational understanding, contextual relevance, and cultural meaning-making. It opens up space for dialogue, for critical inquiry, and for transformative learning rooted in identity, community, and collective wisdom. As this global conversation continues to evolve, Zambia—like many nations—has the opportunity to lead in imagining and implementing mathematics education that is not only more inclusive but more truthful to the diverse ways human beings have always understood, explained, and engaged with the world around them.

Indigenous Knowledge Systems in African Mathematics Education

In many African communities, mathematics is not confined to textbooks or classrooms—it lives in the rhythms of everyday life. It is etched into the patterns of woven baskets, calculated in the measurement of harvested grain, and embodied in the symmetrical structures of traditional huts. Indigenous Knowledge Systems (IKS) are deeply embedded in these cultural practices, offering a wealth of

mathematical insight shaped by generations of observation, experimentation, and adaptation. Yet, despite their sophistication and relevance, these knowledge systems remain largely absent from formal education curricula across the continent (Abdullah et al., 2023; Bhattarai, 2021).

This exclusion not only narrows the scope of what is recognized as mathematics but also distances many African learners from the subject itself. For students who grow up immersed in culturally rich mathematical experiences, the failure to see these reflected in the classroom can reinforce a perception that mathematics is foreign, abstract, and inaccessible. Incorporating IKS into mathematics education is therefore not just a pedagogical innovation—it is a necessary act of inclusion and recognition. When learners encounter mathematical concepts through familiar practices like livestock counting, architecture, or artisanal design, they begin to see mathematics as something they already *know*—as something that belongs to them (Kadonsi, 2025; Young et al., 2022).

Studies have consistently shown that this culturally grounded approach improves both learner engagement and academic performance. It helps students bridge the gap between home and school knowledge, fostering deeper comprehension and emotional connection to the subject. More importantly, it affirms learners' cultural identities, counteracting the historical devaluation of African epistemologies within formal education systems.

A key discipline that supports this integration is ethnomathematics—a field that investigates the mathematical ideas embedded in the cultural practices of various societies. Ethnomathematics asserts that all cultures possess systems of quantification, classification, logic, and spatial reasoning, even if these do not align with Western academic conventions. By embracing ethnomathematics, educators can design lessons that are both rigorous and locally relevant, creating opportunities for students to engage with mathematics in ways that honor their own cultural contexts (Bernardi & Santos, 2021; Kits, 2019).

For African learners, this validation is transformative. It affirms that mathematics is not the exclusive domain of a particular culture or history but a universal human endeavor expressed in diverse and meaningful ways. Integrating IKS into the mathematics curriculum allows students to see themselves as *already* mathematical thinkers—capable, creative, and connected to a broader intellectual heritage that extends beyond the classroom walls. In short, the recognition and incorporation of Indigenous mathematical knowledge in African education is not just an academic reform—it is a path toward dignity, inclusion, and the holistic development of learners whose brilliance too often goes unnoticed within Western curricular frameworks.

Barriers to Integrating Indigenous Knowledge in Formal Curricula

While the integration of Indigenous Knowledge Systems (IKS) into mathematics education holds tremendous promise, the path toward actualizing this vision is fraught with complex and deeply rooted barriers. In Zambia—much like in other African nations—efforts to embed IKS into formal curricula often collide with rigid, centralized education systems that leave little space for flexibility or innovation. These

systems, built upon colonial legacies, continue to prioritize standardized content and imported pedagogical frameworks, often at the expense of local cultural knowledge (Kadonsi, 2025; Volante et al., 2024).

For teachers on the ground, this presents a difficult reality. Most educators have been trained in institutions that emphasize Western pedagogical traditions, with little or no exposure to Indigenous knowledge as a legitimate foundation for teaching and learning. Consequently, many teachers find themselves unprepared—or even resistant—to integrate IKS into their classroom practice (Oleyemi & DeBoer, 2022; Bhattarai, 2021). The issue is not simply one of knowledge but of orientation: if educators have internalized the belief that Western knowledge is superior or more rigorous, they may unconsciously dismiss local ways of knowing as unscientific or irrelevant.

This epistemic hierarchy is further compounded by linguistic challenges. In many cases, the language of instruction in mathematics classrooms differs from the language in which Indigenous knowledge is expressed. This dissonance makes it difficult for students to connect abstract concepts with their real-world applications. For instance, a child who understands measurement through farming practices at home may struggle to recognize that same concept in a classroom lesson taught entirely in English (Mbatha, 2024; Habiyaremye et al., 2022). Such linguistic and cognitive disconnects not only hinder comprehension but can also erode students' confidence and sense of belonging in the mathematics classroom.

At a broader level, policy structures continue to act as gatekeepers against the integration of IKS. Educational reforms frequently mirror global trends that emphasize international benchmarks, standardized testing, and global competitiveness—values that often do not account for the cultural specificity and community-rooted nature of Indigenous knowledge (Andrade-Molina, 2023). These top-down reforms, while well-intentioned, rarely consult the very communities whose knowledge they claim to uplift, resulting in policies that are disconnected from the cultural landscapes in which learning takes place.

Addressing these barriers calls for more than surface-level inclusion or tokenistic acknowledgment of IKS. It demands systemic transformation that begins with a reimagining of what counts as knowledge and who gets to decide. Teacher education programs must be restructured to include deep, critical engagement with Indigenous epistemologies. Curriculum design should be participatory and co-created with local communities, elders, and cultural experts. Language policies need to reflect the multilingual realities of learners, enabling conceptual bridges between home and school environments. Most importantly, the work of integrating IKS must be framed not as a nostalgic return to the past but as a forward-looking strategy for educational equity, relevance, and innovation. Indigenous knowledge is not static—it evolves, adapts, and offers powerful tools for navigating the complexities of today's world. If education is to be truly inclusive and transformative, it must make space for these ways of knowing—not at the margins, but at the centre of curriculum and pedagogy.

Culturally Responsive Mathematics Pedagogy

At the heart of educational transformation lies the question of *who* the learner is—and whether the classroom affirms or silences that identity. Culturally responsive pedagogy answers this question by affirming that students' cultural backgrounds, lived experiences, and ways of knowing are not obstacles to be overcome, but rich resources to be embraced. Within mathematics education—a space long perceived as abstract, neutral, and culture-free—this approach offers a compelling pathway toward greater inclusivity, equity, and engagement (Levitan & Johnson, 2020; Meaney et al., 2021).

In its most impactful form, culturally responsive pedagogy is not a matter of occasionally inserting ethnic names into word problems or referencing local customs in passing. Rather, it is a deep pedagogical commitment to recognizing, valuing, and building upon the cultural capital that learners bring into the classroom. When mathematics instruction is intentionally grounded in students' cultural realities—be it through storytelling, spatial reasoning in local crafts, or patterns found in music and dance—students begin to see themselves as part of the mathematical narrative, rather than standing outside of it (Brazill et al., 2023).

This connection to culture does more than make content relevant; it transforms the learning environment. Research shows that students who see their identities and communities reflected in classroom instruction tend to exhibit greater academic confidence, stronger perseverance, and a deeper sense of belonging (Nicol et al., 2020). For many learners—especially those from historically marginalized backgrounds—this validation can be the difference between disengagement and empowered learning.

Moreover, culturally responsive pedagogy is relational at its core. It recognizes that meaningful learning is not confined to the teacher-student dynamic but extends to families, elders, and community knowledge holders. Involving these stakeholders in curriculum development and classroom practice ensures that education remains rooted in local values and responsive to community needs. This collaborative approach not only enriches classroom content but also supports sustainability, as reforms are more likely to succeed when they resonate with the lived realities of those they aim to serve (Levitan & Johnson, 2020).

Importantly, this pedagogical shift aligns directly with the broader goals of decolonizing mathematics education. Decolonization is not simply about replacing Western content with Indigenous content—it is about reimagining the very nature of knowledge and teaching. Culturally responsive pedagogy advances this reimagining by promoting empathy, cultural humility, and educational justice. It asks educators to unlearn deficit views of learners, to listen deeply, and to teach in ways that honor the cultural frameworks through which students make sense of the world. In this light, the mathematics classroom becomes more than a site of computation or problem-solving. It becomes a space of identity affirmation, cross-cultural dialogue, and possibility. A space where students learn not just how to calculate, but how to see themselves—and their communities—as capable contributors to mathematical knowledge and the broader human story.

Methodology

This study employs a convergent parallel mixed-methods design to explore how Indigenous Knowledge Systems (IKS) can be meaningfully integrated into mathematics education in Zambia. Rooted in the principles of critical pedagogy and decolonial thought, the research is guided by a commitment to understanding both the observable patterns and the lived experiences of educators navigating this culturally complex and pedagogically significant terrain.

The convergent parallel design was chosen for its ability to collect and analyse quantitative and qualitative data simultaneously, allowing the researcher to compare and integrate findings at the interpretation stage. Quantitative methods were used to identify broad trends in teacher perceptions and instructional practices related to IKS, while qualitative methods offered rich, contextual insights into how these perspectives are shaped by personal histories, institutional expectations, and cultural realities. This design enabled the study to explore not only *what* teachers think and do, but also *why* those beliefs and practices emerge and how they reflect broader social, historical, and epistemological dynamics within Zambia's education system.

We employed a convergent mixed-methods design combining teacher surveys (n = 55) with semi-structured interviews (n = 15). Descriptive statistics and group comparisons (rural/urban) provided contextual orientation but did not dominate interpretation. Interview data were analysed thematically, guided by Afrocentric and decolonial perspectives. Prior to analysis, all statistical assumptions were tested and met. Normality was assessed using Shapiro–Wilk tests, and homogeneity of variances was verified through Levene's tests. Alternative model specifications yielded consistent results. Comprehensive descriptive tables and diagnostic summaries are available upon request.

Data Collection Methods

To provide a comprehensive response to the study's research questions, two complementary data collection methods were employed: quantitative surveys and qualitative interviews. This dual approach was designed to balance breadth and depth—capturing general trends while also offering insight into the nuanced realities of teachers' experiences.

A stratified random sampling technique was used to select 55 mathematics teachers from both urban and rural schools across Zambia's Southern Province. This sampling strategy ensured representation across varied geographical and institutional contexts, acknowledging the diversity of educational settings in the region. Each participant completed a structured survey, developed in alignment with established literature on the integration of Indigenous Knowledge Systems (IKS) and culturally responsive pedagogy (Kadonsi, 2025). The survey featured a series of Likert-scale items that explored teachers' attitudes toward IKS, the challenges they encounter in integrating it into the classroom, and their familiarity with culturally responsive instructional strategies. The goal of the survey was to generate quantitative data that could identify prevailing patterns in perception and practice. It also sought to

illuminate the systemic conditions—such as curricular constraints, teacher training, and institutional support—that shape how IKS is or is not embedded in mathematics education. These findings offered a broad overview of the professional landscape within which Zambian educators are working.

To deepen and contextualize the survey data, the study also conducted 15 semi-structured interviews with purposively selected mathematics teachers. Participants were chosen to reflect variation in teaching experience, school type, geographic location, and personal connection to local knowledge systems. The interviews aimed to uncover how educators conceptualize and navigate the integration of IKS in their everyday teaching. Teachers were invited to reflect openly on their pedagogical decisions, student responses, curriculum constraints, and the cultural implications of their instructional practices. This qualitative approach allowed for the emergence of richly layered narratives, revealing the moral, emotional, and professional complexities of teaching mathematics in postcolonial Zambia. In keeping with ethical and methodological standards, all interviews were audio-recorded with participant consent and transcribed verbatim to preserve the authenticity and depth of each teacher's account (Naidoo, 2021; Seehawer, 2018).

Data Analysis

The analysis of data in this study was guided by the principles of a convergent parallel mixed-methods design, in which quantitative and qualitative data were collected and analyzed independently, then merged to generate a comprehensive understanding of the integration of Indigenous Knowledge Systems (IKS) into mathematics education.

Survey data were analyzed using descriptive statistics, including measures of central tendency and variability, to summarize overall trends in teachers' attitudes toward IKS, their perceptions of institutional and pedagogical challenges, and their reported engagement with culturally responsive teaching strategies. These summaries provided a foundational understanding of the distribution of views and experiences among the sampled teachers. In addition to descriptive measures, inferential statistical techniques were applied to examine potential relationships between teacher characteristics (such as teaching experience, educational qualifications, and school location) and their support for IKS integration. Specifically, Pearson's chi-square tests were used for categorical data to identify statistically significant associations, while independent samples t-tests were used to compare mean scores across groups (e.g., rural vs. urban teachers). These tests were selected for their ability to assess differences in perceptions and practices within and across demographic groups, thereby informing targeted professional development and policy interventions.

The qualitative data, derived from 15 semi-structured interviews, were analysed using thematic analysis. This approach combined both deductive coding, grounded in established theoretical frameworks on decolonial pedagogy and IKS integration (Nxumalo & Mncube, 2018; Naidoo, 2021), and inductive coding, which allowed new and unanticipated themes to emerge from the narratives themselves. The analysis was conducted in multiple rounds: initial codes were assigned to textual segments, which were

then grouped into broader thematic categories. Four prominent themes emerged from the interview data: “curriculum rigidity,” “cultural dissonance in instruction,” “teacher uncertainty,” and “pedagogical resistance and resilience.” These themes collectively captured the tensions teachers navigate as they attempt to reconcile externally imposed curricular models with the cultural knowledge embedded in their communities. Teachers described the emotional labour of negotiating conflicting expectations, the creative strategies they employ to include IKS in constrained environments, and their aspirations for more inclusive and affirming forms of mathematics instruction.

By triangulating statistical patterns with narrative depth, the analysis provided a multi-layered understanding of the educational and cultural dynamics surrounding IKS integration. This approach ensured that the findings were not only robust in terms of empirical rigor, but also responsive to the lived realities of educators striving to make mathematics education more culturally meaningful and locally relevant.

Ethical Considerations

This study was conducted in full compliance with established ethical research protocols, as approved by the research ethics committee of the affiliated academic institution. All participants were provided with a detailed informed consent form, outlining the purpose of the study, their voluntary participation, and their right to withdraw at any stage without penalty. The confidentiality and anonymity of participants were strictly protected; all identifying information was removed from data sets, and responses were securely stored to prevent unauthorized access.

In addition to institutional requirements, the study placed significant emphasis on cultural ethics—a vital consideration in research involving Indigenous knowledge and local communities. The development of interview protocols was done in consultation with local educators and community representatives, ensuring that the language, tone, and intent of the questions aligned with cultural norms, sensitivities, and expectations. This collaborative process helped to build trust and affirmed participants' voices as co-constructors of knowledge, not merely subjects of study. The research was guided by the principle that Indigenous Knowledge Systems are not only a topic of inquiry but also a source of intellectual and cultural dignity. As such, care was taken not just to avoid harm, but to foster a respectful, empowering research process—one that recognized the historical marginalization of Indigenous ways of knowing and sought to contribute meaningfully to their reclamation and affirmation.

Analytical Framework

This study is grounded in a critical pedagogical framework, which views education not as a neutral transmission of knowledge, but as a deeply socio-political and cultural practice. From this perspective, mathematics education is understood as being entangled in histories of power, colonial influence, and systemic exclusion (Mandikonza, 2019; McGowan, 2019). Far from being apolitical, the teaching of

mathematics often reproduces dominant narratives that silence or marginalize non-Western epistemologies—particularly in postcolonial contexts like Zambia.

The critical pedagogical lens shaped both the design and interpretation of this study. It provided a foundation for asking not only *how* Indigenous Knowledge Systems (IKS) can be integrated into mathematics education, but also *why* such integration is necessary in the first place. At its core, the framework insists on the importance of educational approaches that are equity-driven, culturally responsive, and liberatory—approaches that affirm learners' identities and disrupt entrenched hierarchies of knowledge. In this context, Indigenous knowledge is not treated as an optional supplement or culturally decorative element. Rather, it is positioned as an equally legitimate and intellectually rigorous system—a way of understanding and interacting with the world that deserves to be placed at the center of educational discourse and practice. This framing calls for a redefinition of mathematics education, one that values relationality, local contexts, and intergenerational knowledge transfer alongside analytical reasoning and formal abstraction.

The use of this framework enabled a reflexive and layered analysis of teacher perspectives, institutional barriers, and pedagogical possibilities. It made space for complexity, contradiction, and dialogue—allowing the study to capture both the constraints teachers face and the agency they exercise within those constraints. Most importantly, it supported the ethical imperative of the research: to affirm and elevate Indigenous Knowledge Systems as vital to shaping mathematics education that is not only inclusive, but also culturally sustaining and socially transformative. Through this lens, the study contributes to a growing movement in African scholarship that seeks to decolonize education by embedding local knowledge systems into the heart of teaching and learning. It envisions a future where Zambian mathematics classrooms are spaces of resonance, relevance, and resistance—where all students can see themselves reflected in the knowledge they are invited to explore.

Findings Illustrated Through Historical-Cultural Vignettes

This section presents the results of the study as guided by the three research questions and analysed through a convergent parallel mixed-methods design. The findings are organized thematically, reflecting the conceptual priorities of the study: (1) the impact of IKS marginalization on educational outcomes, (2) the role of culturally responsive pedagogy in inclusive mathematics teaching, and (3) strategies for integrating IKS into curriculum and practice. Quantitative and qualitative data were analysed independently and then integrated to provide a layered and holistic understanding. The quantitative results offer broad trends and group comparisons, while the qualitative findings offer contextualized insights from teacher narratives. The integration of these strands aims to deepen understanding of both systemic patterns and lived experiences related to the inclusion of Indigenous Knowledge Systems in Zambian mathematics education.

Prior to conducting inferential analyses, all statistical assumptions were checked. For the independent samples *t*-tests, normality was assessed using the Shapiro-Wilk test, and Levene's Test was used to

assess the equality of variances. The assumptions of normality and homogeneity of variance were met. For the chi-square test of independence, expected cell frequencies were verified, with all values exceeding the minimum threshold of 5, thus satisfying the test's assumptions.

Impact of IKS Marginalization on Mathematics Education Outcomes

The findings revealed a significant concern among educators regarding the limited presence of Indigenous Knowledge Systems (IKS) in the current mathematics curriculum. Specifically, 78.2% of survey respondents agreed or strongly agreed that IKS is insufficiently represented in Zambian mathematics education, while 64% reported that this exclusion contributes to learner disengagement—especially in rural communities.

To further examine whether perceptions differed by teaching context, an independent samples *t*-test was conducted comparing rural and urban teachers' attitudes toward IKS integration. The results indicated a statistically significant difference: rural teachers (M = 4.20, SD = 0.51) rated the relevance of IKS more highly than their urban counterparts (M = 3.50, SD = 0.72), $t(53) = 2.31$, $p = .024$. These findings suggest that teachers embedded in rural communities—where Indigenous knowledge is closely tied to everyday practices—are more attuned to the disconnection between classroom content and learners' cultural realities.

This quantitative pattern was echoed in the qualitative data. Teachers consistently described a curriculum that fails to reflect learners' lived experiences. One rural teacher explained:

My pupils know how to measure land or count goods in markets, but that doesn't appear in our textbooks. It's like their home knowledge is invisible in class.

(Interview 3)

Other participants emphasized that this cultural exclusion erodes learners' academic confidence and identity, with one teacher noting that students often "don't see themselves in the mathematics they're being taught."

These findings collectively highlight the ongoing marginalization of IKS as both a curricular and pedagogical concern, with direct implications for learner engagement and equity in mathematics education. Figure 2 below summarizes the key quantitative findings related to teacher perceptions of IKS marginalization.

These challenges point to the need for alternative pedagogical approaches—ones that centre the learner's cultural identity. The next section explores how culturally responsive pedagogy offers such a pathway."

Culturally Responsive Pedagogy as a Pathway to Inclusion

The data suggest that while culturally responsive pedagogy holds promise for inclusive teaching, it remains underutilized and insufficiently supported within the current educational framework. Quantitative survey results revealed that 72.7% of mathematics teachers reported being either *somewhat familiar* or *not familiar at all* with culturally responsive teaching practices. Moreover, only 9.1% indicated that they had received formal training specifically focused on integrating Indigenous Knowledge Systems (IKS) into classroom mathematics instruction.

To determine whether exposure to localized training opportunities had an effect on instructional practices, a chi-square test of independence was conducted. A statistically significant relationship was observed between participation in community-based educational programs and the use of culturally responsive teaching strategies, $\chi^2(1, N = 55) = 7.82$, $p = .005$. This result suggests that teachers who had received community-grounded professional development were more likely to incorporate Indigenous examples, analogies, and culturally relevant scenarios into their lessons.

This quantitative finding was further supported by qualitative insights. Several teachers described how small pedagogical shifts—rooted in learners' cultural contexts—dramatically changed classroom dynamics and levels of engagement. One urban teacher reflected:

When I used traditional patterns from beadwork to explain geometry, the girls became more confident. It felt like they saw themselves in the lesson for the first time.

(Interview 6)

Classroom observations and artefact-based tasks further demonstrated how Indigenous knowledge systems informed mathematics learning in practical and culturally resonant ways. Three illustrative contexts emerged from the data, showing how community-based mathematical practices were successfully integrated into classroom instruction.

Learners identified multiple forms of **plane symmetry, tessellation, and geometric transformation** in locally woven baskets. Through guided exploration, they photographed or sketched community artefacts, marked lines of symmetry, and described transformation sequences such as translation, rotation, and reflection. Learners subsequently created their own woven-pattern designs using similar mathematical rules. Observations revealed consistent evidence of proportional reasoning and pattern regularity across learner artefacts and local craft samples, supported by artisan interviews and school-community artefact audits.

Learners applied **traditional land-measurement techniques** such as pacing and rope-length estimation, conducting repeated trials to compare indigenous results with standard metric measures. Recorded data showed small but consistent variations across trials, enabling computation of ratios, unit conversions, and estimation errors. Field records and interviews with local farmers and elders confirmed the persistence of embodied and terrain-responsive measurement systems still used in community agricultural practices.

In the market-based task, learners collected real-world data on price, quantity, and mark-ups from local vendors. They used these data to calculate **ratios, percentages, and profit margins**, comparing traders' heuristic computations with formal classroom methods. Observations and vendor interviews indicated strong use of mental estimation and proportional reasoning strategies optimized for speed and practical accuracy.

Despite the effectiveness of these culturally grounded approaches, teachers emphasized that most practices were developed **informally**, without institutional recognition or structured curricular support. Participants expressed a strong desire for formalized professional development spaces where culturally responsive mathematics strategies could be designed, refined, and shared systematically.

Figure 3 below summarizes the distribution of teachers' reported familiarity with culturally responsive pedagogy and the extent of formal training received.

In light of these findings, the next section presents teacher-identified strategies and structural frameworks necessary to support the meaningful integration of Indigenous Knowledge Systems (IKS) into mathematics education in Zambia.

Strategies and Frameworks for Effective IKS Integration

When asked what would support the effective integration of Indigenous Knowledge Systems (IKS) into mathematics education, teachers shared clear and consistent priorities. The majority of respondents, accounting for 82%, emphasized the need to incorporate IKS into both pre-service and in-service teacher education programs. This was followed closely by 75% who advocated for the development of locally relevant teaching materials that reflect the lived experiences and cultural contexts of learners. In addition, 68% of teachers supported greater collaboration with community elders and cultural experts, highlighting the importance of integrating authentic Indigenous knowledge sources into teaching practice.

These preferences are summarized in Fig. 4, which illustrates the proportion of teachers who endorsed each of the proposed strategies for IKS integration.

Figure 4 summarizes the key strategies identified by teachers as essential for the effective integration of Indigenous Knowledge Systems into mathematics education. These include formal teacher training, the development of culturally relevant materials, and collaboration with community knowledge holders. The qualitative findings that follow provide deeper insight into these priorities, emphasizing that teachers view IKS integration not as a symbolic gesture, but as a necessary and systemic transformation requiring sustained institutional commitment and curricular reform.

The qualitative findings provided deeper insight into these statistical trends. Teachers consistently stressed that IKS integration should move beyond occasional or symbolic inclusion, and instead be anchored in a systemic approach that includes formal training, structured resources, and curricular alignment. Several participants advocated for participatory curriculum development, whereby teachers,

curriculum specialists, and community knowledge holders work collaboratively to co-create mathematics content that is both academically rigorous and culturally meaningful.

One teacher captured this sentiment by stating: *"Elders and artisans know a lot about numbers, measurements, and patterns. We should bring them into the classroom—not as guests, but as co-teachers." (Interview 11)*

There was also a notable call for policy reform to ensure that Indigenous knowledge is not merely viewed as an optional add-on, but as a legitimate and integral component of mathematics education. Teachers expressed a desire to see IKS formally embedded in curriculum standards and assessment frameworks, thereby affirming its role in shaping not only what is taught, but how learning is understood and valued in Zambian classrooms.

Cross-Cutting Themes

Across both the quantitative and qualitative data, several interwoven themes emerged that reveal the broader systemic and pedagogical landscape shaping IKS integration in mathematics education. Figure 5 below visually synthesizes these four cross-cutting themes, highlighting their interconnected nature and their influence on the integration of Indigenous Knowledge Systems in classroom practice.

A prominent theme was curriculum rigidity. Teachers consistently described the national mathematics syllabus as overly prescriptive, offering minimal room for adaptation to local contexts or cultural relevance. This rigidity, they noted, limits innovation even when teachers are personally motivated to incorporate Indigenous content. One teacher remarked,

We are bound by the syllabus. Even if I know how to teach with local examples, the system pushes me to stick to what's written.

(Interview 2)

Closely related was the theme of cultural dissonance in instruction. Educators highlighted a persistent disconnect between students' everyday experiences and the mathematics examples provided in formal curricula particularly in rural areas. Learners struggled to engage with unfamiliar, abstract content, often perceiving mathematics as foreign or irrelevant. As one rural teacher explained,

Our syllabus talks about elevators and shopping malls, but my learners have never seen those. They don't connect it feels like math is for someone else's world.

(Interview 7)

The third theme that emerged was teacher uncertainty and professional gaps. While many teachers expressed strong interest in using IKS, they also acknowledged a lack of formal training and instructional materials to do so confidently. The burden of integrating culturally responsive strategies was often left to individual effort. One participant confessed,

I want to include local knowledge in my lessons, but I've never been taught how. I'm just trying things on my own.

(Interview 10)

Despite these systemic constraints, a final theme—pedagogical resistance and resilience stood out. Teachers described instances where they used local contexts, stories, or artifacts to make mathematics more relatable and engaging, even without institutional support. These efforts reflected a quiet form of resistance and deep professional commitment. As one urban teacher shared,

When I used patterns from beadwork to explain shapes, the class came alive. It wasn't in the textbook, but it worked.

(Interview 6)

Together, these themes reveal a complex but hopeful landscape. While the structural barriers to IKS integration are significant, the presence of teacher insight, creativity, and cultural awareness presents a strong foundation for reform. With appropriate support through teacher education, curriculum flexibility, and policy recognition, this foundation could become a catalyst for meaningful transformation in mathematics education across Zambia.

Emerging Framework for IKS Integration in Mathematics Education

The themes and patterns identified across both data sets point to a pressing need for a holistic, context-sensitive approach to Indigenous Knowledge Systems (IKS) integration in mathematics education. In response to the challenges of curriculum rigidity, cultural dissonance, teacher preparedness, and the absence of institutional support as well as the demonstrated resilience and innovation of educators—this study proposes a four-pillar framework to guide sustainable, culturally rooted transformation.

The framework emphasizes four interconnected components: curriculum reform and decolonization, culturally responsive teacher training, community knowledge collaboration, and learner identity engagement. These pillars emerged directly from the data and are designed to respond to the specific realities of mathematics classrooms in Zambia. Figure 6 below illustrates this conceptual framework, which serves as both a synthesis of the findings and a strategic guide for policy, teacher development, and curriculum design.

Re-situating School Mathematics within Local Histories of Practice

This discussion interprets the findings of the study within the broader context of mathematics education reform in Zambia and the call for decolonized pedagogy. Grounded in a convergent mixed-methods design, the study examined how Indigenous Knowledge Systems (IKS) can be meaningfully integrated

into mathematics education, with particular attention to teacher perspectives, systemic barriers, and culturally responsive strategies. The findings are discussed through the lens of the Afrocentric theoretical framework, which emphasizes the centering of African epistemologies and cultural agency in educational processes (Chawane, 2016; Ringstaff, 2023).

By engaging both quantitative patterns and teacher narratives, the discussion illuminates the tension between standardized, Western-derived curricula and the lived experiences of learners in culturally diverse Zambian communities. It also highlights emerging opportunities to reimagine mathematics education as a space for cultural affirmation, equity, and epistemological pluralism.

Impact of IKS Marginalization on Mathematics Education Outcomes

One of the most salient findings from this study is the widespread perception among educators that IKS is severely underrepresented in the current mathematics curriculum. A significant majority (78.2%) of respondents agreed or strongly agreed that IKS is insufficiently incorporated, while 64% linked this absence to learner disengagement, particularly in rural contexts. This aligns with previous research showing that disconnection from culturally embedded knowledge contributes to students feeling alienated in the classroom (Powell et al., 2023; Kadonsi et al., 2023; Shimwandi et al., 2024).

This exclusion has profound consequences for student identity and participation. As Nasir and Royston (2013) assert, mathematics is not a culturally neutral discipline; it is imbued with social meaning and power. When learners especially those from Indigenous communities do not see their cultural reasoning reflected in the curriculum, they are more likely to internalize the idea that mathematics is exclusive, foreign, or irrelevant to their lived experiences (Craddock, 2023; Garcia-Olp et al., 2022). Such cultural disconnects often manifest as lower engagement, diminished confidence, and reduced aspirations in STEM-related fields (Fauzi et al., 2022; Kadonsi et al., 2023).

The quantitative data showing significant differences between rural and urban teachers further reinforce this view. Rural teachers, who are more immersed in local knowledge practices, rated the relevance of IKS to mathematics instruction significantly higher ($M = 4.20$, $SD = 0.51$) than their urban counterparts ($M = 3.50$, $SD = 0.72$), $t(53) = 2.31$, $p = .024$. This suggests that proximity to cultural practices makes the exclusion of IKS more visible and problematic. As noted by Kyeremeh et al. (2024), the contextual relevance of mathematics teaching is more readily understood in rural areas where learners' mathematical knowledge such as land measurement, trade-based estimation, and spatial reasoning is drawn from real-life experience rather than abstract formalism.

These statistical patterns were echoed powerfully in the teacher narratives. One rural educator shared,

“My pupils know how to measure land or count goods in markets, but that doesn’t appear in our textbooks. It’s like their home knowledge is invisible in class.” (Interview 3)

Such statements reflect what Ladson-Billings (1995) called the "cultural mismatch" in education, where the dominant curriculum marginalizes the lived knowledge systems of non-dominant communities. Students are thereby forced to navigate between school-based and community-based knowledge structures, often without institutional recognition or support (Shimwandi et al., 2024).

The Afrocentric theoretical lens is particularly instructive in making sense of these dynamics. Afrocentricity positions African learners not as passive recipients of imported knowledge but as central actors in the co-construction of educational content (Chawane, 2016; Ringstaff, 2023). From this vantage point, the exclusion of IKS from mathematics instruction is not a neutral curricular decision it is a continuation of colonial epistemologies that privileged Western mathematical traditions while erasing local systems of quantification, estimation, and problem-solving. The adoption of a decolonial approach, therefore, is not simply a matter of content inclusion but a profound act of epistemic justice.

Integrating IKS into mathematics education offers a powerful counter-narrative. Research has shown that incorporating culturally embedded practices such as indigenous measurement systems, traditional geometric patterns, and community-based reasoning models can dramatically improve student engagement and self-efficacy (Mendrofa et al., 2024; Moloi & Matabane, 2020). Such practices allow learners to see themselves reflected in the mathematics classroom—not as subjects of deficit but as holders of valuable, complex, and rigorous knowledge.

In this study, teachers particularly those in rural areas expressed a strong desire for such transformation. Yet they also acknowledged the lack of curricular support, training, and institutional recognition to implement these ideas meaningfully. This highlights a systemic failure to align the curriculum with the cultural and cognitive realities of learners, perpetuating structural inequities under the guise of standardization and universality.

Culturally Responsive Pedagogy as a Pathway to Inclusion

Culturally Responsive Pedagogy (CRP) has emerged as a transformative approach in the quest to decolonize education and foster equitable learning environments particularly in mathematics classrooms that have historically marginalized non-Western epistemologies. In the context of Zambia, this study found that while CRP holds considerable promise for inclusion and engagement, its implementation remains severely constrained by systemic, pedagogical, and institutional barriers.

Quantitative results revealed that 72.7% of teachers surveyed reported being either only somewhat familiar or not familiar at all with culturally responsive teaching practices. Alarmingly, just 9.1% indicated having received formal training on integrating Indigenous Knowledge Systems (IKS) into mathematics instruction. These figures mirror findings from broader literature (Sawita et al., 2024; Robinson, 2023), which consistently highlight a glaring gap in professional development on CRP despite its potential to enhance student participation, identity formation, and achievement.

Further analysis confirmed that teachers who participated in community-based education programs were significantly more likely to use culturally responsive strategies, $\chi^2(1, N = 55) = 7.82$, $p = .005$. This supports existing research indicating that when educators are grounded in local contexts, they are better equipped to bridge the gap between formal curriculum and learners' cultural experiences (Banerjee & Gautam, 2024; Barton & Tan, 2020; Goering et al., 2022). Grounded training provides teachers with tools to use Indigenous examples, analogies, and culturally embedded problem-solving thus transforming abstract content into relatable, lived mathematics.

Qualitative narratives revealed the emotional and pedagogical depth of CRP. Teachers described moments when integrating local cultural elements such as traditional beadwork or agricultural practices made mathematics “come alive” for students. One urban teacher remarked:

When I used traditional patterns from beadwork to explain geometry, the girls became more confident. It felt like they saw themselves in the lesson for the first time.

(Interview 6) Such moments exemplify the power of culturally responsive teaching to affirm identity and build student confidence, especially among historically marginalized groups (Stylianidou & Nardi, 2023; DC & Rokaya, 2023). This affirmation is particularly critical in mathematics education, a field often perceived as objective and culture-free but in reality shaped by power, privilege, and exclusion (Garcia-Olp et al., 2022; Valoyes-Chávez & Andrade-Molina, 2022).

However, the transformative potential of CRP is undermined by its informal status within the institutional ecosystem. Teachers in this study emphasized that most culturally responsive strategies were developed individually—without structured guidance, peer collaboration, or curricular alignment. As noted in earlier scholarship (Alameddine, 2021; Jackson et al., 2023), this lack of systemic support reduces CRP to a peripheral practice, rather than embedding it as a normative pedagogical model. This marginalization limits its reach, scalability, and sustainability within broader educational reforms.

The Afrocentric theoretical framework helps contextualize these findings. Afrocentricity asserts that African learners should not merely be recipients of imported knowledge but recognized as producers of meaning grounded in rich cultural traditions (Chawane, 2016; Ringstaff, 2023). Within this framework, CRP is not just a pedagogical technique it is an act of epistemic justice (Jacobson et al., 2022), a process of restoring value to the knowledge systems of communities that have long been rendered invisible in the formal curriculum.

Teachers in the study advocated for stronger collaboration with community elders, artisans, and cultural experts, not as one-off guests but as co-creators of curriculum content. This aligns with global literature calling for participatory approaches in inclusive STEM education (White et al., 2020; Roca et al., 2023). A teacher noted:

Elders and artisans know a lot about numbers, measurements, and patterns. We should bring them into the classroom—not as guests, but as co-teachers.

(Interview 11)

This vision goes beyond symbolic inclusion of IKS. It reimagines mathematics classrooms as spaces where learners engage with knowledge that is intellectually rigorous and culturally affirming. It also reframes teaching as a community-rooted practice responsive to local wisdom, context, and student identity. Yet, to realize this vision, systemic transformation is needed. CRP must be formally recognized in teacher training institutions, curriculum standards, and instructional resources. As long as its implementation depends on teacher goodwill or isolated innovation, CRP will remain fragmented and vulnerable to institutional neglect (Roos, 2023; Andrade-Molina, 2023).

Strategies and Frameworks for Effective IKS Integration:

The integration of Indigenous Knowledge Systems (IKS) into mathematics education is more than an issue of curricular reform it is a transformative educational project with implications for identity, justice, and national development. Teachers in this study expressed a deep-seated belief that the success of IKS integration depends not on symbolic gestures, but on deliberate and system-wide reforms. Their reflections point to a growing awareness that educational equity, particularly in postcolonial contexts like Zambia, demands pedagogical approaches rooted in cultural relevance and epistemic recognition.

One of the central insights from the data is that teachers are not passive actors waiting for top-down reform. Rather, they are already engaging in culturally responsive practices drawing from their communities, local traditions, and lived experiences to enrich classroom learning. However, these efforts often occur informally, without institutional recognition or curriculum-aligned support. As a result, many educators feel isolated, and their innovations remain vulnerable to institutional neglect. This sense of marginalization highlights the urgent need for systemic structures that validate and sustain grassroots educational practices.

The call for integrating IKS into teacher training both pre-service and in-service reflects a broader demand for cultural competence in professional preparation. Teachers recognize that without foundational training that values local knowledge, many educators may lack the confidence or strategies needed to integrate IKS meaningfully. This resonates with broader literature that emphasizes the importance of culturally responsive training in fostering more equitable and effective teaching practices (MacDonald et al., 2022; Anor, 2025). It also speaks to the necessity of reorienting teacher education away from imported models and toward frameworks that prepare educators to teach in context.

Equally compelling is the emphasis placed on locally relevant teaching materials and participatory curriculum design. The teachers in this study did not merely ask for new textbooks—they advocated for a reimagining of what counts as knowledge in mathematics education. In calling for collaboration with community elders and cultural experts, they positioned local knowledge holders not as adjuncts but as co-educators. This view aligns with Afrocentric educational theory, which insists that communities must play a central role in shaping the learning experiences of their children.

Furthermore, there was a shared understanding among participants that without policy reform, IKS integration risks remaining fragmented and inconsistent. Teachers pointed to a disconnect between what they believe is educationally valuable and what the curriculum and assessment systems currently reward. This tension underscores a fundamental issue in postcolonial education systems: the persistence of colonial epistemologies in defining academic legitimacy. To move toward epistemic justice, policy frameworks must evolve to not only permit but champion Indigenous perspectives as integral to national development and intellectual identity. These findings contribute to the broader discourse on decolonizing education by articulating a vision for mathematics learning that is not only locally grounded but globally relevant. When Indigenous knowledge is woven into the curriculum with care, intention, and institutional backing, it has the power to transform classrooms into spaces of affirmation and agency. As such, this study supports calls for participatory, culturally sustaining pedagogies that disrupt dominant narratives and reframe learners as producers not just consumers of knowledge.

Ultimately, the discussion of strategies for IKS integration is a discussion about educational transformation. It is about recognizing that the mathematics classroom can be a site of healing, empowerment, and cultural revival if we are willing to redesign its foundations in partnership with the communities it serves.

Based on the findings, this study proposes a four-pillar conceptual framework to guide the effective and sustainable integration of IKS into mathematics education in Zambia. This framework responds directly to teacher-identified priorities and is grounded in Afrocentric, decolonial, and equity-centered educational theory. The proposed framework includes four interconnected components that emerged directly from the data. First, curriculum reform and decolonization calls for a mathematics syllabus that reflects Indigenous epistemologies and dismantles colonial structures embedded in current educational models. Next, culturally responsive teacher training emphasizes the need for teacher preparation programs and professional development that engage with local cultural contexts and equip educators to teach inclusively. A third component, community knowledge collaboration, advocates for partnerships with elders, artisans, and cultural knowledge holders to co-create meaningful instructional content. Finally, learner identity engagement focuses on affirming students' cultural backgrounds and lived realities as central to their mathematical development and confidence.

Cross-Cutting Themes: Navigating Tensions, Building Possibilities

The integration of Indigenous Knowledge Systems (IKS) into mathematics education in Zambia reveals a complex interplay of systemic constraints and educator ingenuity. Findings from both qualitative and quantitative strands converge on four key themes: curriculum rigidity, cultural dissonance, teacher uncertainty, and pedagogical resistance and resilience. Teachers consistently described the national mathematics curriculum as overly rigid and standardized, restricting their ability to adapt lessons to local contexts. This inflexibility, tied to entrenched notions of "official knowledge," often marginalizes

Indigenous ways of knowing. Additionally, a deep cultural disconnect between the content of mathematics instruction and students' lived experiences especially in rural areas—undermines learner engagement and reinforces a sense of alienation from the subject.

Many educators expressed uncertainty about how to integrate IKS due to a lack of training, institutional support, and culturally responsive resources, revealing professional gaps that hinder innovation. Despite these barriers, teachers demonstrated remarkable resilience, finding creative ways to incorporate local knowledge, artifacts, and cultural practices into their teaching. Their efforts reflect a commitment to educational equity and epistemological inclusion, though they often operate without systemic backing. Overall, the study underscores that true integration of IKS in mathematics education requires more than curriculum adjustments—it calls for a fundamental transformation of teacher preparation, curriculum design, and policy frameworks, grounded in the recognition of Indigenous knowledge as academically legitimate and pedagogically powerful.

Conclusion

The integration of Indigenous Knowledge Systems (IKS) into mathematics education in Zambia emerges from this study not simply as an educational innovation, but as a transformative necessity. Teachers' voices throughout the research reveal a consistent desire to move beyond tokenistic gestures and into a space of genuine curricular and pedagogical reform one that recognizes local knowledge not as ancillary, but as foundational to effective teaching and learning.

The findings suggest that the persistent marginalization of IKS in the mathematics curriculum undermines learner engagement, particularly among rural students whose cultural and mathematical competencies are too often rendered invisible in the classroom. Yet, what is equally evident is the resilience and agency of teachers who, despite systemic constraints, are already drawing on local resources, traditions, and contexts to make mathematics more accessible, relevant, and empowering. At the core of the study is a call for systemic change. Teachers emphasized that without structured training, policy alignment, and institutional support, their efforts to integrate IKS will remain fragmented and informal. The need for formal recognition of IKS in both teacher education and curriculum development cannot be overstated. Teachers require not only permission, but pedagogical tools and policy backing to teach in ways that reflect the realities of their learners.

This study therefore proposes a four-pillar framework curriculum reform and decolonization, culturally responsive teacher training, community knowledge collaboration, and learner identity engagement—as a strategic approach to guiding the integration of IKS. Each pillar is interdependent and grounded in the lived realities of Zambian classrooms. Together, they offer a pathway toward a mathematics education that affirms learners' identities, draws strength from community wisdom, and challenges the colonial legacies embedded in current educational structures. Ultimately, this research affirms that educational equity cannot be achieved without cultural relevance. The integration of IKS into mathematics education is not about adding more content to the curriculum it is about reimagining the purpose and structure of

education itself. When learners see their knowledge, languages, and cultural practices reflected in what they are taught, mathematics becomes more than abstract numbers; it becomes a language of affirmation, belonging, and possibility. In this vision, Indigenous knowledge is not merely preserved it is elevated, positioned at the heart of a more just and inclusive educational future.

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Figures

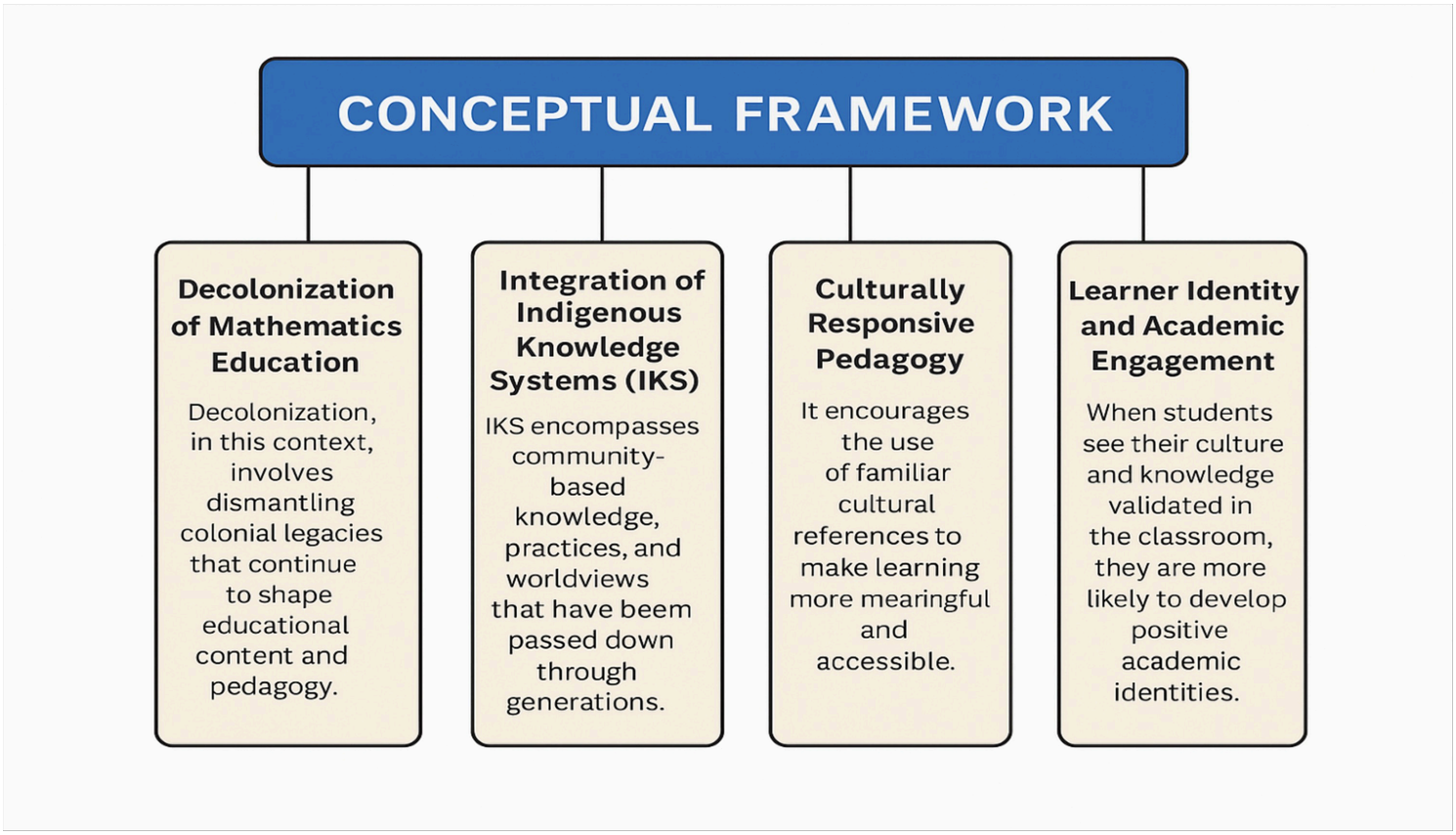


Figure 1

Theoretical Lens and Study Framework.

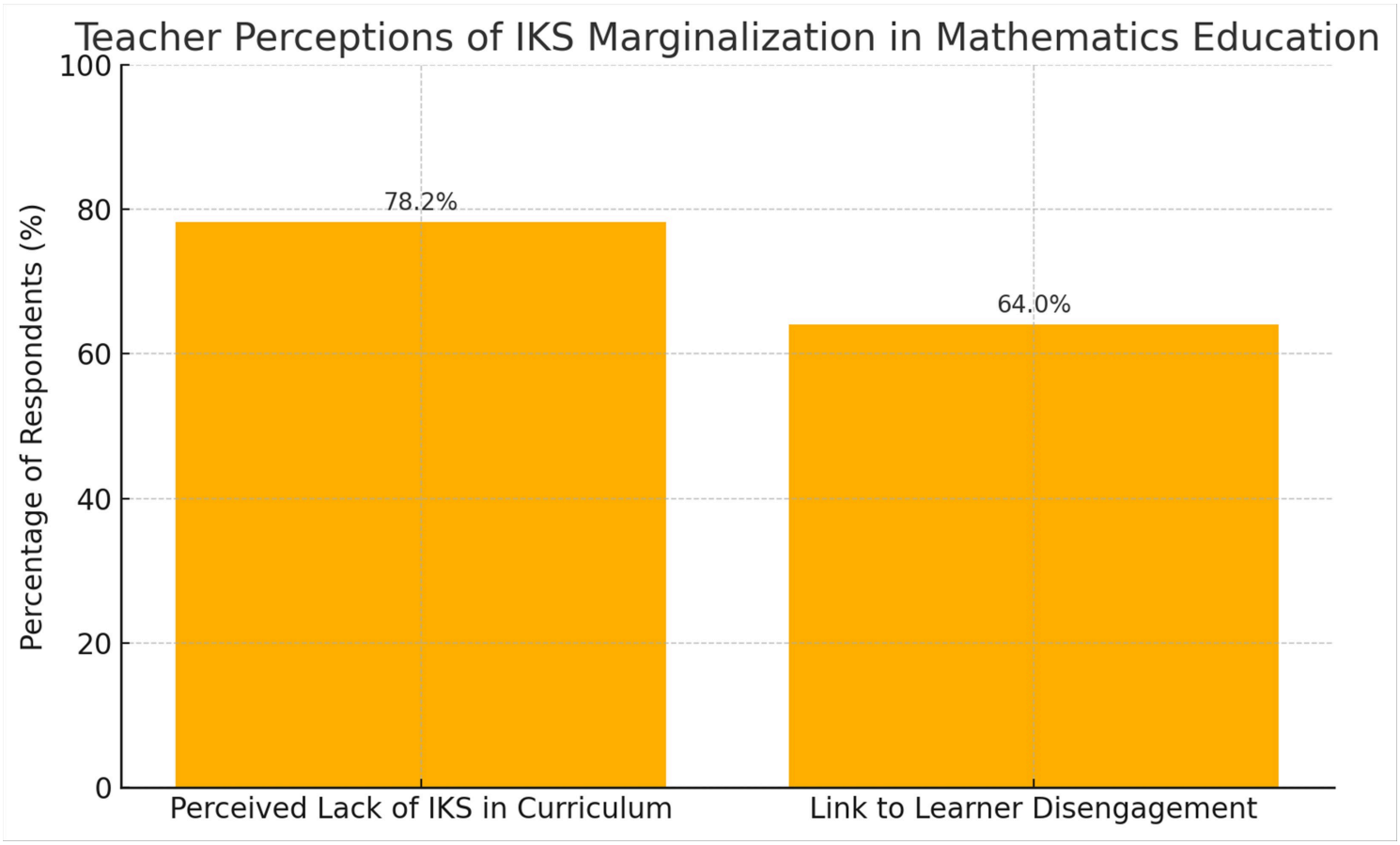


Figure 2

Teacher Perceptions of IKS Marginalization in Mathematics Education (N=55)

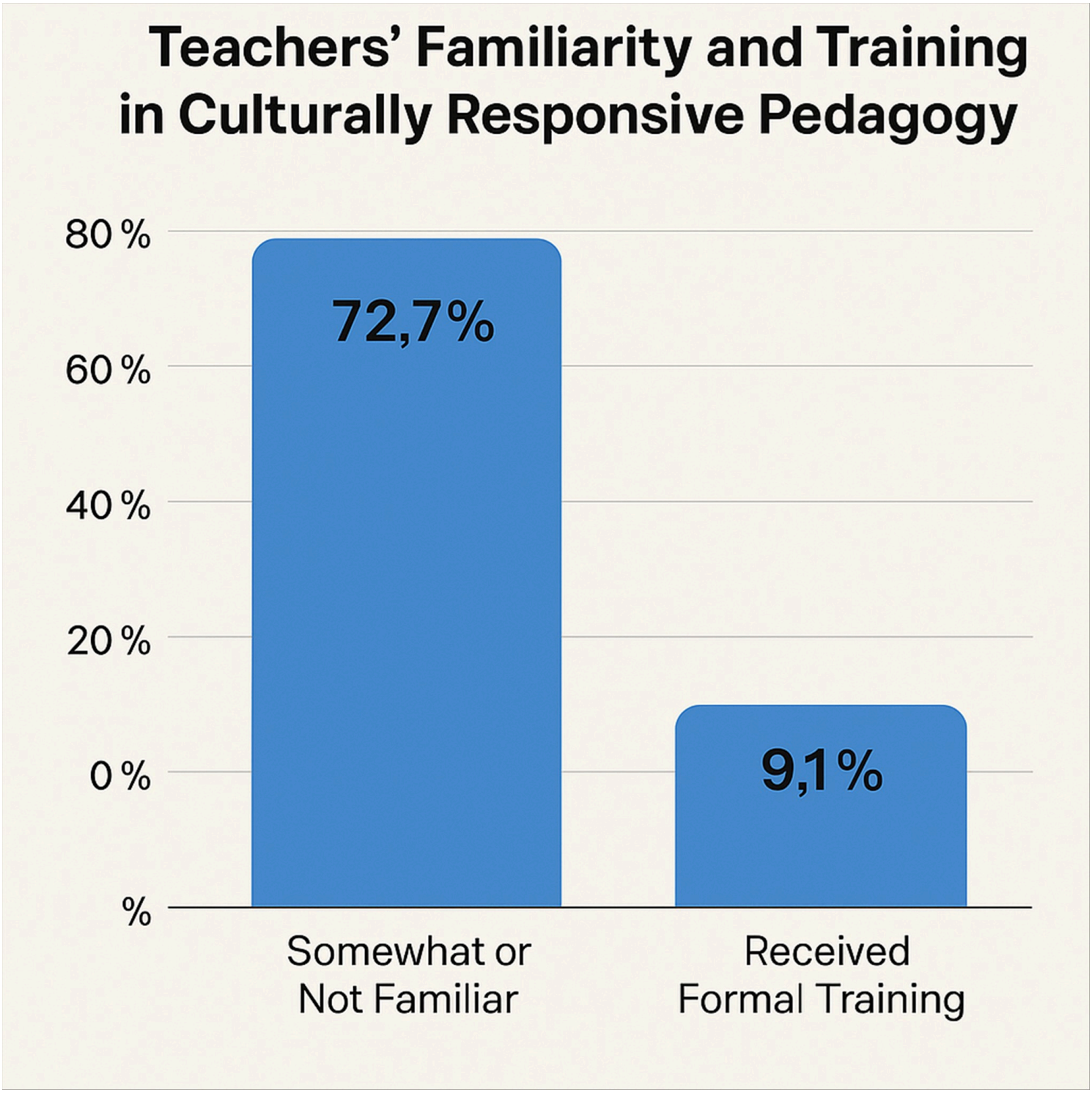


Figure 3

Teachers' Familiarity and Training in Culturally Responsive Pedagogy

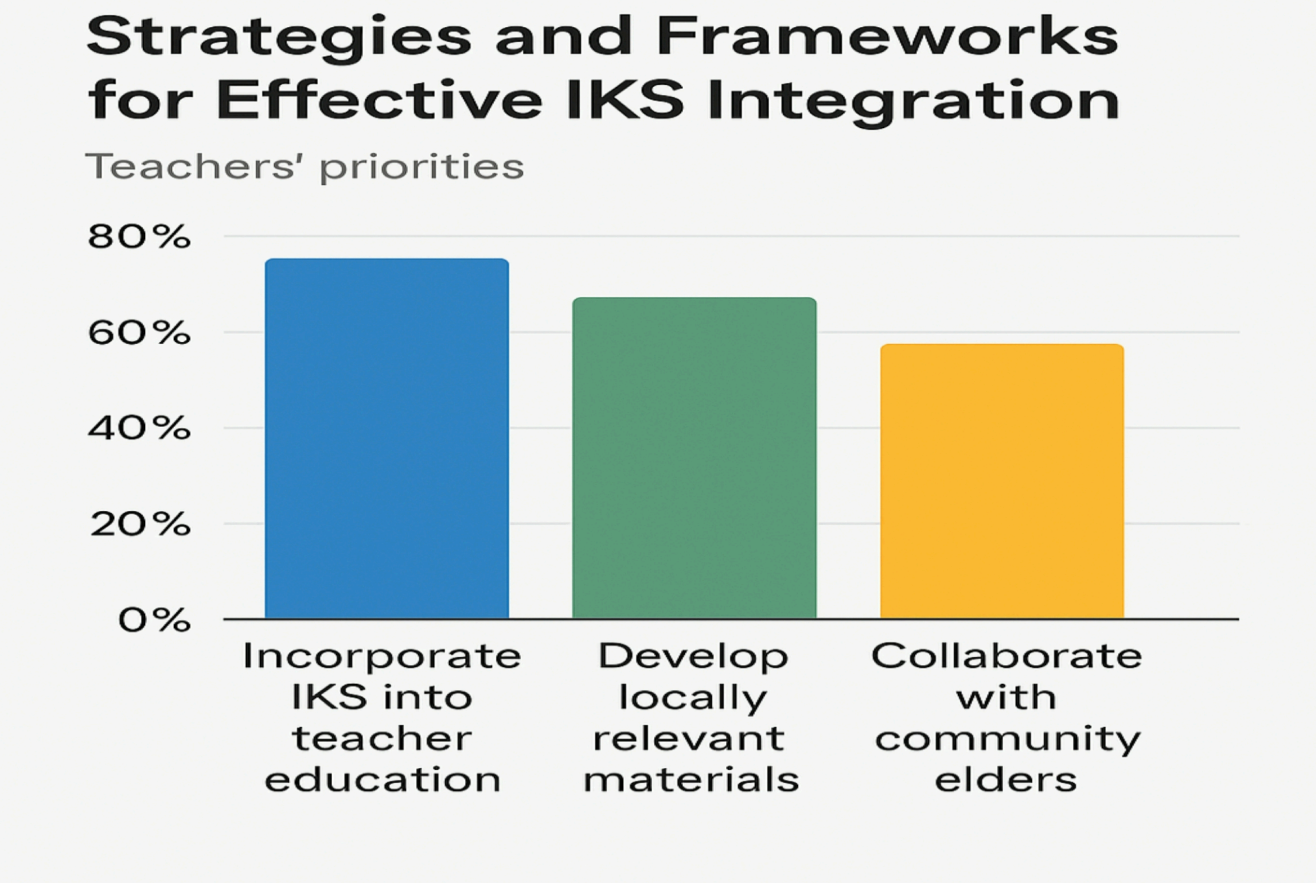


Figure 4

Strategies and Frameworks for Integrating IKS into Mathematics Education

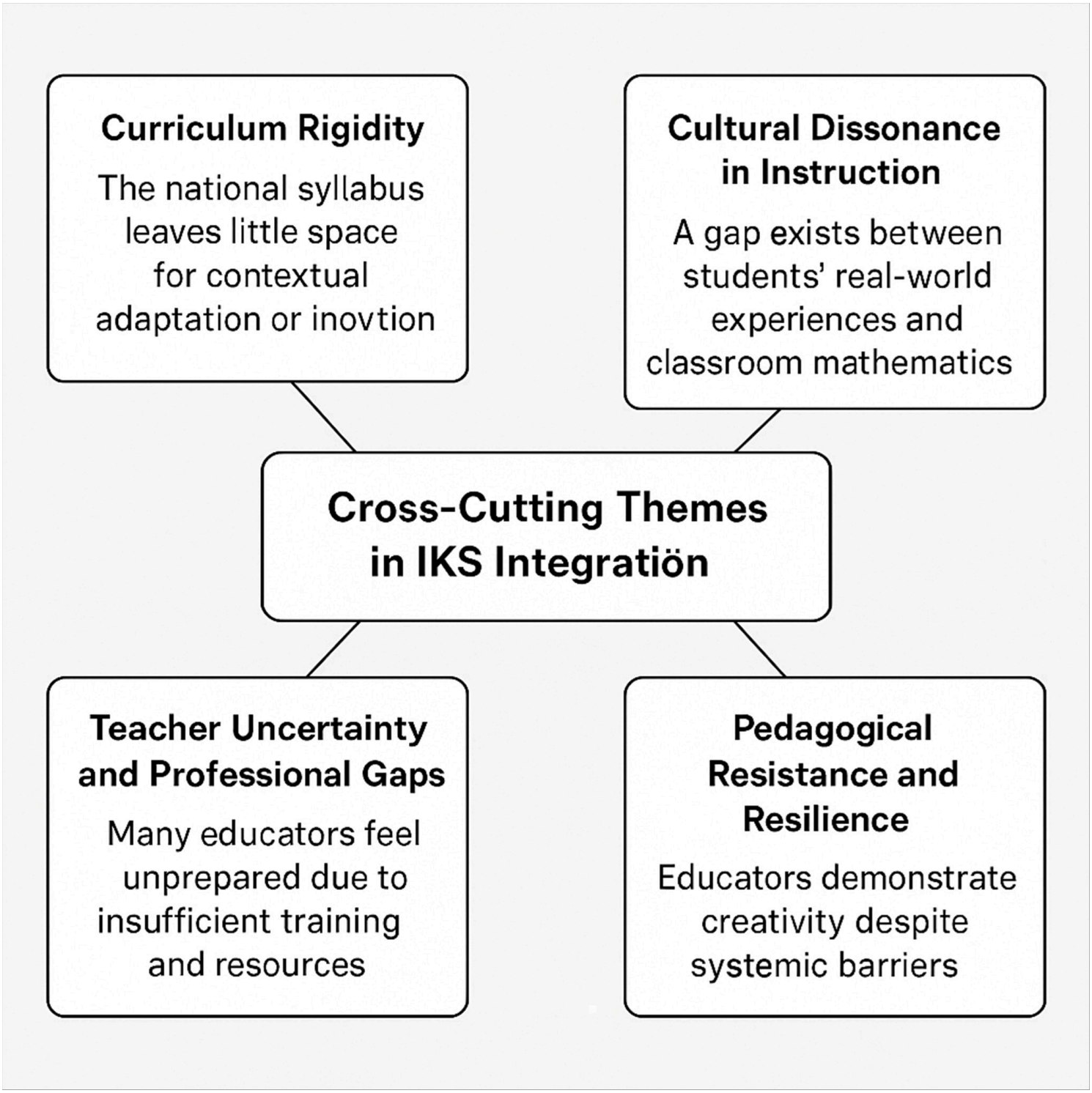


Figure 5

Cross-Cutting Themes in IKS Integration

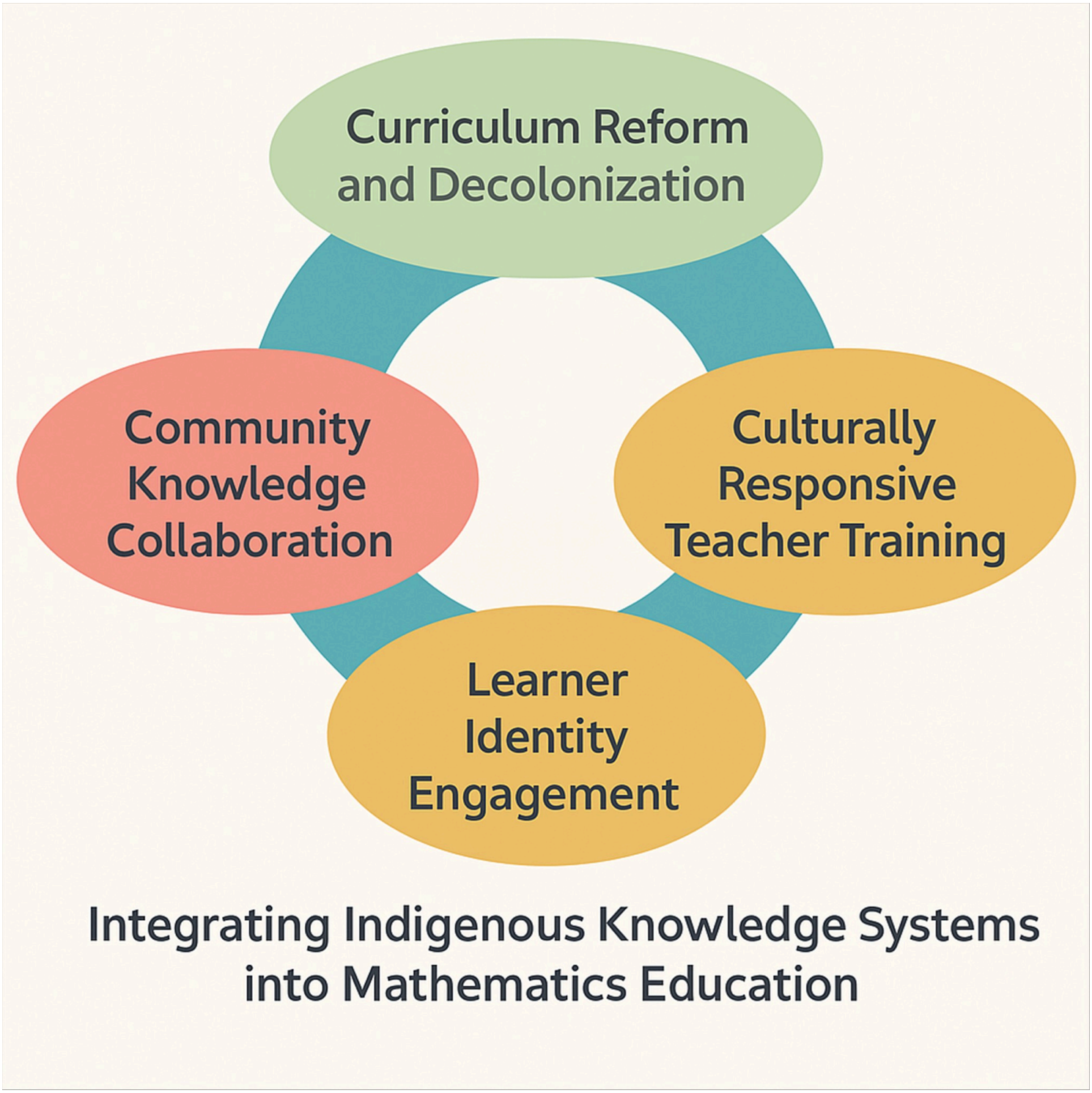


Figure 6

Unnumbered image in the Findings Illustrated Through Historical-Cultural Vignettes section.