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FROM SYMBOLIC TO EMPIRICAL: CONFIRMATORY FACTOR ANALYSIS OF INDIGENOUS KNOWLEDGE INTEGRATION SYSTEM INTO GHANAIAN BASIC EDUCATION CURRICULUM FOR SUSTAINABLE FUTURES

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Abstract

This study develops and validates a multidimensional measurement model of teachers' indigenous knowledge systems (IKS) integration practices in Ghana's basic education curriculum. Grounded in culturally responsive pedagogy and the funds of knowledge framework, an explanatory sequential mixed-methods design was employed. Qualitative data from focus group discussions informed the development of the Marifah Indigenous Knowledge Integration Scale (MIKIS), validated using confirmatory factor analysis (CFA) within data from 35 teachers. The final model specified three (3) latent constructs: Lesson Planning and Alignment (LPA), Implementation Challenges (CI), and Community and Cultural Engagement (CCE). Results indicated acceptable to excellent model fit ($\chi^2 (17) = 18.30, p = .368$; CFI = .991; TLI = .985; RMSEA = .047; SRMR = .060). Standardised factor loadings ranged from .789 to .941, exceeding recommended thresholds. Composite reliability (CR) and average variance extracted (AVE) confirmed convergent validity, while discriminant validity was supported using the Fornell-Larcker criterion. The findings provide empirical evidence for conceptualising IKS integration as a structured, measurable pedagogical construct. The validated instrument offers a practical tool for policy evaluation, teacher development, and culturally responsive curriculum reform in Ghana and similar Global contexts.

Keywords: Indigenous Knowledge Systems, Confirmatory Factor Analysis, Curriculum Validation, Culturally Responsive, Basic Education.

1. Introduction

Globally, education systems recognise the importance of incorporating culturally relevant knowledge into teaching and learning processes (African Union, 2025; African Union Commission, 2015). This is because post-colonial societies prioritise formal education systems as historically privileged Western epistemologies, while marginalising indigenous knowledge systems that have long shaped local cultures, livelihoods, and ecological systems. This imbalance has generated growing scholarly concerns and policy debates regarding the need to integrate indigenous knowledge into formal education to promote culturally responsive pedagogy and sustainable development (Ministry of Education, 2019; NaCCA, 2019, 2020).

Operationally, indigenous knowledge encompasses locally generated knowledge systems that evolve through long-term interactions between communities and their ecology. This knowledge system includes cultural practices such as festivals, funerals, naming ceremonies, oral traditions, such as myths, totems, or taboos, and ecological knowledge such as farming practices and weather indigenous terminologies and social values that guide community life (Adom et al., 2024; Benson, 2021; Gbene et al., 2021; Chieminah & Gbana, 2018). These scholarly works emphasise that integrating IKS into formal education can enhance learning relevance, strengthen cultural identity, and improve educational outcomes for learners in culturally diverse societies (Adom et al., 2024; Benson, 2021). On 25th October 2025, the Ghanaian minister of education re-echoed the use of the local language (*LI*) in instruction to enhance learners' comprehension and indigenous language acquisition (Appiah, 2025).

Ghanaian education curriculum reforms have increasingly emphasised the need to integrate indigenous knowledge into formal education (National Council for Curriculum and Assessment, 2019, 2020, 2024). Also, Ghanaian national educational policies, including the Education Strategic Plan (2018-2030), the Standard-Based Curriculum (SBC), and Common Core Programme (CCP), encourage teachers to draw upon local cultural practices, traditional knowledge and community resources as part of classroom instructions (Ministry of Education, 2019; NaCCA, 2019, 2020). Despite these policy directions, the implementation remains inconsistent due to limited empirical research identifying how teachers operationalise indigenous knowledge integration in practice.

A plethora of studies on indigenous knowledge integration relied heavily and primarily on conceptual analysis, qualitative case studies or descriptive approaches (Adom et al., 2024; Benson, 2021; Gbene et al., 2021; Chieminah & Gbana, 2018). While these contributions provide significant insight into the value of indigenous knowledge in education, there remain limited quantitative studies validating the underlying dimensions of teachers' practices for integrating indigenous knowledge into Ghanaian educational curricula. Therefore, understanding these dimensions is critical for curriculum reform, teacher training, and policy development. Without empirically validated frameworks, its efforts to promote, preserve, and protect indigenous knowledge integrations risk remaining rhetorical rather than practical. Therefore, this study addresses this gap by developing and testing a structural model of teachers' indigenous knowledge integration practices using structural equation modelling. Specifically, this study investigates whether teachers' practices can be conceptualised through six (6) interrelated dimensions: lesson planning and alignment, community knowledge engagement, instructional delivery, assessment and evaluation, teacher beliefs and efficacy, and culturally responsive assessment.

Empirically, validating this model contributes to the growing scholarship on culturally responsive education and indigenous knowledge systems while providing practical guidance

for education policy and teacher professional development in Ghana and similar contexts. The following research questions guided this study:

1. What is the underlying factor structure of teachers' indigenous knowledge Systems (IKS) integration practices?
2. Does the proposed six-factor model demonstrate acceptable psychometric properties in terms of validity and reliability?
3. To what extent do the constructs of lesson planning and alignment, implementation challenges, instructional delivery, assessment and evaluation, teacher beliefs and efficacy, and cultural and community engagement represent IKS integration in practice?

2. Theoretical Contribution

The study makes three (3) key contributions to the literature. This study advances culturally responsive pedagogy by operationalising Indigenous Knowledge Systems (IKS) integration as a measurable, multidimensional construct. Also, the study responds to methodological gaps in existing scholarship by providing a statistically validated instrument (MIKIS) for assessing IKS integration in formal education. Finally, this study contributes to Global education scholarship by offering empirical evidence from Ghana, thereby extending the applicability of a culturally grounded pedagogical framework beyond predominantly Western contexts.

3. Literature Survey

3.1 Indigenous Knowledge Systems in Education

Globally and in African educational reform, the integration of Indigenous knowledge Systems (IKS) into formal education has emerged as a critical agenda. Scholarships emphasise that IKS provides learners with contextualised, relevant epistemologies that enhance participation, engagement, cultural identity, and community relevance (da Silva et al., 2024; Mandikonza, 2019). The inclusion of indigenous perspectives is viewed as a strategy for decolonising curriculum and challenging the historical dominance of Eurocentric knowledge structures within the postcolonial education era (Gupta, 2024). Scholarships emphasise that culturally grounded instructions improve student motivation, participation, and cognitive connection to learning content (Gupta & Dhingra, 2025). Students' competencies, including critical cultural awareness, community participation, and identity affirmation, are developed through indigenous knowledge integration (Miuka & Tufu, 2025; Mandikonza, 2019). The Integration of local histories, oral traditions, symbols, and community practices in the African contexts has been identified as a pathway to culturally sustainable education and endogenous development (da Silva et al., 2024; Mandikonza, 2019).

However, despite these benefits, colonial legacies continue to shape many education systems in Africa (Benson, 2021; Gbene et al., 2021). Formal schooling often prioritises Western scientific knowledge while marginalising indigenous epistemologies. As a result, many learners experience a disconnect between school knowledge and community knowledge (Adom et al., 2024; Benson, 2021). Therefore, an important step towards decolonising Ghanaian curricula is integrating indigenous knowledge into formal education to promote culturally relevant education.

3.2 Culturally Responsive Pedagogy and Community Knowledge

Culturally, responsive pedagogy highlights the importance of using learners' cultural experiences, community knowledge, and social contexts as foundations for teaching and learning (Howard, 2021; Gay, 2018; Ladson-Billings, 1995). Doing so promotes effective teaching, which requires educators to recognise and value learners' cultural identities while incorporating culturally engaging content into instruction (da Silva et al., 2024; Gay, 2018).

Studies including Bejdo et al. (2025), Fenech et al. (2025), Hogg (2012), Rios-Aguilar et al. (2011), and Gonzalez et al. (1993) have shown that culturally responsive teaching improves learner engagement, motivation, and academic achievement. Therefore, teachers who employ culturally responsive strategies often integrate local examples, community knowledge, and culturally relevant content teaching resources into the classroom instruction tailored to learners' needs and expectations (Fenech et al., 2025; Gay, 2018). Culturally responsive pedagogy provides a conceptual framework for understanding how teachers can bridge formal curricula with community-based knowledge systems (Miuka & Tufu, 2025).

Theoretically, IKS integration is linked to culturally responsive pedagogy (Howard, 2021; Gay, 2018; Ladson-Billings, 1995). This framework highlights the importance of aligning instructions with learners' cultural experiences and social realities (Gay, 2018). Similarly, the funds of Knowledge theory (Bejdo et al., 2025; Fenech et al., 2025; Hogg, 2012; Rios-Aguilar et al., 2011; Gonzalez et al., 1993) emphasises the role of households and communities as rich sources of knowledge that can enhance classroom experience. These perspectives can be operationalised in the classroom and curriculum by teachers to engage in culturally grounded lesson planning, collaborate with community knowledge holders, and adapt instructional strategies to local contexts. Conversely, teachers are often faced with structural and pedagogical barriers such as limited training, lack of instructional resources, and uncertainty about curriculum alignment (da Silva et al., 2024; Gay, 2018).

3.3 Funds of Knowledge Perspective

This framework emphasises the importance of recognising and understanding the pivotal role of households and community as repositories of valuable intellectual resources (Bejdo et al., 2025; Fenech et al., 2025; Hogg, 2012; Rios-Aguilar et al., 2011; Gonzalez et al., 1993). The funds of knowledge perspective postulates that learners bring diverse forms of cultural knowledge into the classroom as resources from their environment (Bejdo et al., 2025; Fenech et al., 2025). Therefore, teachers can capitalise on the resources to enrich academic learning when effectively integrated into teaching. Teachers who draw on community knowledge systems create opportunities for learners to connect academic concepts with real-life experiences in the classroom (Bejdo et al., 2025; Hogg, 2012). This practice enhances comprehension by strengthening relationships between schools and local communities in integrating IKS into learners.

3.4 Indigenous Knowledge Integration

Despite the policy emphasis on IKS integration, empirical measurement of IKS integration remains scarce. Many of the existing scholarships are conceptual or advocacy-oriented, with few fragmented validated interventions available to assess the extent and quality of implementation. Without reliable measurement tools, the evaluation of curriculum reforms and teacher practices remains difficult. A confirmatory factor analysis (CFA) provides a rigorous methodological approach for validating multidimensional constructs in educational settings (Wang et al., 2026; Wu et al., 2026; Fung, 2022). CFA will enable the testing of theoretically specified relationships between observed indicators and latent variables and the development of psychometrically sound instruments. To monitor policy implementation, guide professional development, and generate evidence-based insights for culturally responsive curriculum reform, validated measurement tools are essential. The study addresses the identified gap by validating a CFA-based measurement model of Indigenous Knowledge integration within Ghana's basic Education context.

3.5 Theoretical Framework

This study integrates three (3) complementary theoretical perspectives, including culturally responsive pedagogy (Howard, 2021; Gay, 2018; Ladson-Billings, 1995), funds of knowledge (Bejdo et al., 2025; Fenech et al., 2025; Hogg, 2012; Rios-Aguilar et al., 2011; Gonzalez et al., 1993), and the indigenous knowledge systems framework (Wang et al., 2026; Wu et al., 2026; Fung, 2022). These frameworks collectively conceptualise indigenous knowledge integration as a multidimensional teaching process involving interactions between teachers, learners, and community (Wang et al., 2026; Bejdo et al., 2025; Fenech et al., 2025; Howard, 2021). These frameworks emphasise the effective use of culturally grounded instructions to provide intentional curriculum alignment, meaningful engagement with community knowledge systems, and the capacity to navigate contextual constraints (Howard, 2021; Ladson-Billings, 1995). This framework emphasises the pivotal role of teachers in translating indigenous knowledge into classroom practices through lesson planning, instructional strategies, community engagement, and assessment methods. These practices collectively shape how indigenous knowledge becomes embedded within the formal educational process. This forms the basis for the measurement model tested using confirmatory factor analysis.

Conceptual Framework

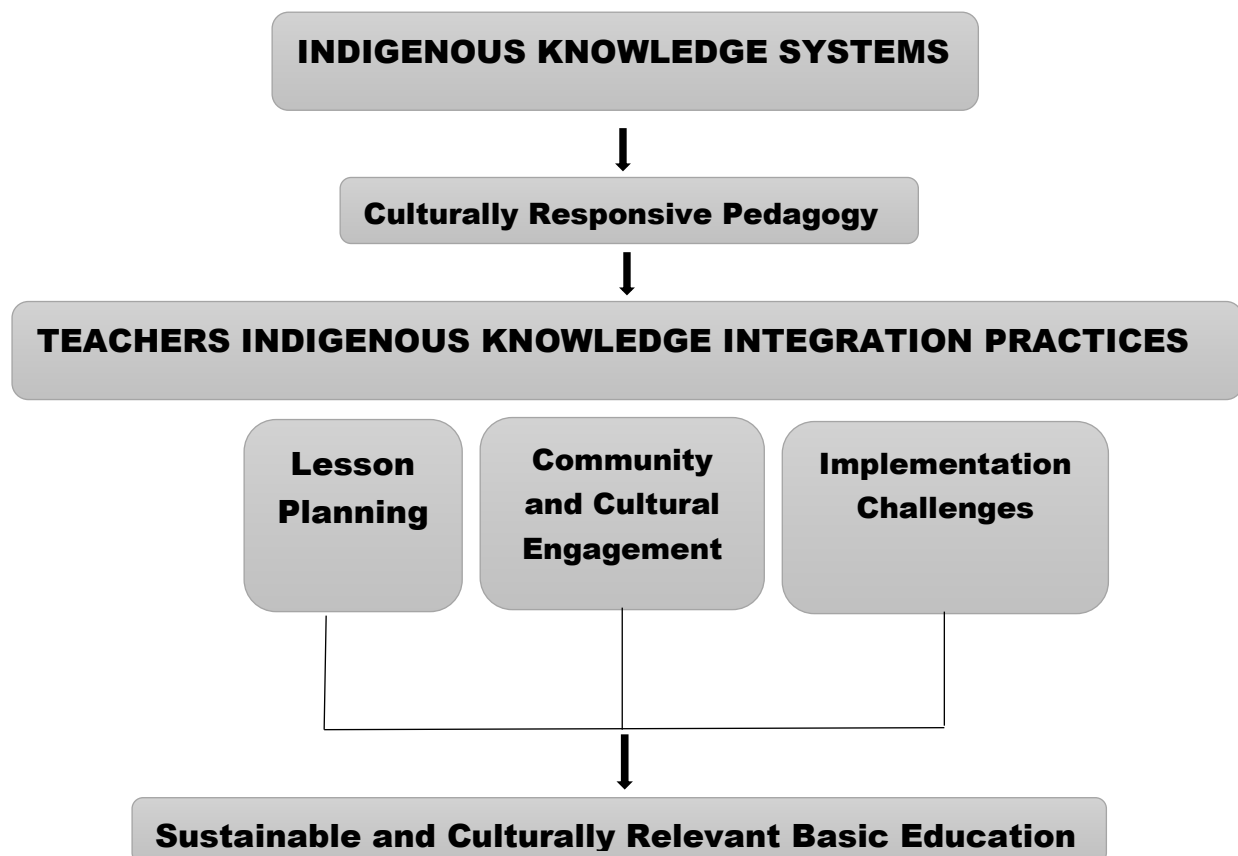


Fig. 1. *Conceptual framework*
(Researchers construct, 2026)

The conceptual framework in Figure 1 presents Indigenous Knowledge Systems (IKS) as the cultural and epistemic foundations for teaching and learning. Culturally responsive pedagogy is the instructional approach and teachers' indigenous knowledge integration practices as the operational mechanism through which the indigenous narratives, symbols, and community knowledge enter the classroom. In this framework, teachers translate indigenous knowledge

into lesson planning and to the students through community and cultural engagement with indigenous traditional knowledge holders, making basic education more culturally relevant and sustainable. Although the study originally presents the framework broadly, the empirical findings refine it into three (3) validated dimensions: Lesson Planning and Alignment, Implementation Challenges, and Community and Cultural Engagement. This shows that IKS integration into basic education is a structured pedagogical process rather than a symbolic classroom add-on.

4. Methodology

4.1 Research Design

This study adopted an explanatory sequential mixed-method design, integrating qualitative exploration with quantitative validation (Hirose & Creswell, 2023; Creswell & Creswell, 2018). The qualitative phase informed the development of measurement items grounded in indigenous epistemologies, while the quantitative phase assessed the psychometric properties of the resulting instrument using confirmatory factor analysis (CFA). This design ensured both contextual depth and statistical rigour.

4.2 Qualitative Phase

This phase involved semi-structured focus-group discussions with key informants knowledgeable about Nyibivian clan totems. A snowball sampling technique was employed to identify participants, ensuring that those with relevant expertise were included (Bouncken et al., 2026; Stratton, 2024). A total of four (4) focus group discussions were conducted with a membership of between 5 and 10. Data saturation was reached after the 3rd focus group discussion. This indicates that sufficient coverage of key themes related to clan totemic knowledge (Bouncken et al., 2026; Guest et al., 2020). The focus group discussions on philosophical clan composition, mythical narratives, symbolic representations, and cultural practices were transcribed and analysed thematically using Otter and MAXQDA (24.4.1) software. Data analyses involved reading and highlighting repeated patterns to familiarise with the data, generating codes such as 'Totemic Reverence Identity', code memo such as 'people who revere the crocodile', generating creative coding (categories) such as 'Totemic Identity', and generating themes including 'Totemic Agency and Survival Guidance', and finally presenting the report for discussion.

4.3 Instrument Development

Data from the qualitative phase informed the development of the Marifah Indigenous Knowledge Integration Scale (MIKIS). A 25-item structured questionnaire adapted from the Culturally Responsive Teaching Self-Efficacy Scale (CRTSE) and the Culturally Responsive Teaching Outcome Expectancy Scale (CRTOE) developed by Siwatu (2007), designed to measure teachers' practices in integrating clan totemic culture into lesson planning and alignment, instructional delivery, assessment and evaluation, teachers' beliefs and efficacy, cultural and community engagement, and implementation challenges. The instrument was validated for content and cultural appropriateness through expert review by two (2) curriculum specialists and one (1) indigenous knowledge researcher. Items were rated on a five-point Likert Scale ranging from 1 'Not confident at all' to 5 'Extremely confident' (Bejdo et al., 2025; Adom et al., 2024).

4.4 Quantitative Phase

The quantitative phase employed a cross-sectional survey design to collect data from 35 teachers selected from three basic schools (Taffiasi, Bujan, and Nanchalla) using the census sampling within the Nyibivian clan. Confirmatory factor analysis (CFA) and structural equation modelling were conducted to validate the multidimensional measurement model of indigenous knowledge integration, focusing on lesson planning, alignment, implementation challenges, cultural and community engagement, assessment and evaluation, instructional delivery, and teacher beliefs and efficacy (Wang et al., 2026; Fung et al., 2022). Standardised factor loadings, convergent validity, discriminant validity, and model fit indices (CFI, TLI, RMSEA, SRMR) were examined to ensure psychometric robustness.

4.5 Participants and Sampling

Participants for this study included 35 basic schoolteachers from three public schools in the Nyibivian clan (Bujan, Taffiasi, and Nanchalla), Sisaala East Municipality. A multistage sampling procedure was used to ensure representation across schools and teaching levels. In the first stage, Sisaala East Municipality was purposefully selected based on its cultural diversity and the presence of indigenous knowledge practices within local communities (Bouncken et al., 2026; Stratton, 2024). In the Second stage, Snowball sampling identified participants for the qualitative phase. Schools within the Nyibivian clan were randomly selected within the municipality (Ahmed, 2024; Hossan et al., 2023). The census sampling was adopted to include all eligible teachers within the selected clan schools, thereby ensuring full representation of the accessible population (Muyembe Asenahabi & Anselemo Ikoha, 2023; Latpate et al., 2021)

In this study, a total of N= 35 teachers participated. Although the sample size is relatively small for structural equation modelling, previous methodological studies indicate that stable parameters estimate may be obtained in CFA models with high factor loadings ($\geq .70$), few indicators per construct and simple model structure (Kline, 2023; McNeish & Wolf, 2023; Hair & Alamer, 2022; Hair et al., 2021; Brown, 2015; Wolf et al., 2013; MacCallum et al., 1999; 2001). This current study satisfies these conditions. In addition, model robustness was assessed using conservative fit indices and reliability measures (McNeish & Wolf, 2023; Watkins, 2021; MacCallum et al., 1999, 2001). Nonetheless, the findings of this study should be interpreted with caution and validated in larger samples.

4.6 Validity and Reliability

Content validity was established through expert review by specialists in curriculum studies and indigenous knowledge research. Construct validity was assessed using confirmatory analysis. Internal consistency reliability was evaluated using Cronbach's alpha, McDonald's Omega, and Composite reliability.

4.7 Data Screening and Assumption Testing

Before the analysis, the dataset was screened to ensure accuracy and suitability for CFA. Missing data were assessed, and none were identified. Multivariate outliers were examined using Mahalanobis distance, and no observations exceeded the critical threshold. Inter-item correlations were inspected to assess multicollinearity, with all values remaining .85, indicating that the constructs were related but empirically distinct. Normality assumptions for maximum likelihood estimation were assessed using skewness and kurtosis statistics. All values fell within recommended thresholds for SEM analysis, supporting the use of maximum likelihood estimation.

4.8 Data Analysis Procedure

This study's measurement model was refined iteratively. Items with factor loadings below .70 were removed based on theoretical relevance and statistical criteria (McNeish & Wolf, 2023; Watkins, 2021). Modification indices were examined to identify areas of model misfit, ensuring that item removal improved both construct validity and model parsimony.

4.9 Final Measurement Model

The final model retained three latent constructs: Lesson Planning and Alignment (3 indicators), Implementation Challenges (3 indicators), and Community and Cultural Engagement (2 indicators). The refined model demonstrated strong factor loadings and satisfactory reliability and validity, confirming the theoretical structure of Indigenous Knowledge integration practices.

4.10 Mixed- Method Integration

The integration of qualitative and quantitative findings was conducted to ensure coherence between the exploratory and validation phases. Qualitative themes derived from focus group discussions were translated directly into CFA constructs. Culturally grounded lesson designs informed the Lesson Planning and Alignment (LPA) construct, structured and pedagogical barriers contributed to the Implementation Challenges (IC) construct, and community participation themes operationalized the Community and Cultural Engagement (CCE) construct. Quantitative CFA results confirmed the robustness of these qualitatively derived constructs, demonstrating alignment between inductive insights and deductive validation. A joint display table was used to map qualitative themes to CFA constructs, further strengthening methodological rigour.

4.11 Ethical Considerations

This study's ethical approval was obtained from the Kwame Nkrumah University of Science and Technology Ethics Committee (No: HuSSREC/AP1456/VOL.5) before data collection. Participation was voluntary, and informed consent was obtained from all respondents. Participants were assured of anonymity and confidentiality, and no personally identifiable information was collected. Respondents were informed that the data would be used solely for academic research purposes and that they could withdraw at any time without penalty.

5. Results

5.1 Measurement Model

Table 1 presents factor loadings obtained from the measurement model assessing teachers' practices for integrating indigenous, specifically mythical narratives of clan totems into classroom instruction. A critical loading threshold of 0.70 was adopted as the minimum acceptable criterion for item retention (Hair et al., 2021). Items with loadings below this threshold were removed from the final model to improve construct validity and measurement reliability.

5.2 Lesson Planning and Alignment

The results indicate that the Lesson Planning and Alignment construct demonstrated strong factor loadings for most items. Specifically, LPA_1 ($\beta = 0.941$), LPA_4 ($\beta = 0.842$), and LPA_2 ($\beta = 0.789$) exhibited strong loadings, suggesting that teachers' ability to design lesson plans integrating mythical clan narratives, adapt creative arts activities using clan symbols, and map clan myths to curriculum strands are central indicators of indigenous knowledge integration during lesson planning. Consequently, LPA_3 showed a moderate but acceptable loading ($\beta = 0.679$) and was removed, indicating that aligning clan narratives with the Standard- Based Curriculum (SBC) and Common Core Programme (CCP) is an important

aspect of lesson planning practices. However, LPA_5 ($\beta = 0.330$) fell below the critical threshold and was therefore removed, suggesting limited consistency in teachers' ability to scaffold lessons linking oral myths with competency-based learning outcomes.

5.3 Instructional Delivery

Within the Instructional Delivery construct, three items demonstrated strong factor loadings: ID_4 ($\beta = 0.761$), ID_3 ($\beta = 0.736$), and ID_5 ($\beta = 0.716$). These findings indicate that the application of culturally responsive pedagogy, facilitating classroom discussions using clan narratives and integrating oral traditions into teaching practices, represents key instructional competencies for indigenous knowledge integration. However, ID_2 produced a moderate loading ($\beta = 0.607$), suggesting that adapting instructional strategies to cultural contexts contributes meaningfully to the construct but was removed. In contrast, ID_1 produced a negligible loading ($\beta = 0.000$) and was removed from the model, indicating that this item did not adequately represent the latent construct.

5.4 Community and Cultural Engagement

The Community and Cultural Engagement construct result shows that CCE_4 demonstrated strong loading ($\beta = 0.816$), suggesting that teachers can engage learners in community-based projects that reflect cultural heritage. Conversely, CCI_1 ($\beta = 0.448$), CCE_2 ($\beta = 0.638$), and CCE_3 ($\beta = 0.461$) did not meet the required loading threshold and were removed from the final model, indicating weaker alignment between these cultural engagement practices and the underlying construct.

5.5 Teacher Beliefs and Efficacy

The Teacher Beliefs and Efficacy construct results indicate that TBE_1 demonstrated a strong loading ($\beta = 0.792$), suggesting that teachers' belief in the role of cultural narratives in strengthening learner identity is a key attitudinal component of indigenous knowledge integration. Contrarily, TBE_2 ($\beta = 0.437$) and TBE_3 ($\beta = 0.376$) did not meet the required loading threshold and were removed from the final model, indicating weaker alignment between these belief statements and the underlying construct.

5.6 Implementation Challenges

The Implementation Challenges construct exhibited particularly strong factor loadings across all items. Specifically, IC_2 ($\beta = 0.844$), IC_3 ($\beta = 0.822$), and IC_1 ($\beta = 0.819$) all demonstrated strong loadings, indicating that teachers' ability to identify challenges, manage constraints, and troubleshoot curriculum alignment issues is a robust indicator of the implementation challenges associated with integrating indigenous knowledge into classroom practice. Finally, the measurement model refinement process resulted in the removal of several weak/invalid items ($< .70$) while retaining those that demonstrated acceptable loadings above the critical threshold ($\geq .70$). The retained indicators provided empirical support for the multidimensional structure of indigenous knowledge integration practices, encompassing lesson planning, instructional delivery, assessment practices, community engagement, teacher beliefs and implementation challenges. The removal of weak items improved the construct validity and reliability of the measurement model, thereby strengthening the empirical basis for subsequent confirmatory factor analysis and structural modelling.

Table 1. *Measurement Tool Indicators and Reliability*

Indicator	Item	Loading Factor (β)	Critical Loading Factor	Description
Lesson Planning and Alignment	<i>LPA_1</i> : I can design lesson plans that integrate mythical narratives of clan totems into my lessons.	0.941	≥ .0.70	Strong/ Retained
	<i>LPA_2</i> : I can adapt activities to include symbols and stories from clan totems.	0.789	≥ .0.70	Strong/ Retained
	<i>LPA_3</i> : I can align clan narratives with Standards-Based Curriculum or Common Core Programme learning outcomes.	0.842	≥ .0.70	Strong/ Retained
	<i>LPA_4</i> : I can map clan myths to strands/sub-strands in my lessons.	0.679	≥ .0.70	
	<i>LPA_5</i> : I can scaffold lessons to connect oral myths with required competencies.	0.330	≥ .0.70	Valid/ Removed
Instructional Delivery	<i>ID_1</i> : I can use storytelling techniques from indigenous traditions in classroom teaching.	0.000	≥ .0.70	Weak/ Removed
	<i>ID_2</i> : I can facilitate student discussions that interpret clan myths respectfully.	0.368	≥ .0.70	Weak/ Removed
	<i>ID_3</i> : I can facilitate student discussions that interpret clan myths respectfully.	0.409	≥ .0.70	Valid/ Removed
	<i>ID_4</i> : I can facilitate student discussions that interpret clan myths respectfully.	0.480	≥ .0.70	Weak/ Removed
	<i>ID_5</i> : I can facilitate student discussions that interpret clan myths respectfully.	0.238	≥ .0.70	Weak/ Removed
Assessment and Evaluation	<i>IE_1</i> : I can integrate multimedia (audio, images) to present clan narratives.	0.272	≥ .0.70	Weak/ Removed
	<i>IE_2</i> : I can handle sensitive cultural content with care.	0.569	≥ .0.70	Weak/ Removed
	<i>IE_3</i> : I can design assessments incorporating indigenous knowledge.	0.751	≥ .0.70	Weak/ Removed
	<i>IE_4</i> : I can evaluate student learning using culturally relevant criteria.	0.514	≥ .0.70	Weak/ Removed
	<i>IE_5</i> : I can assess competencies through indigenous narratives.	0.448	≥ .0.70	Weak/ Removed
Community and Cultural Engagement	<i>IE_6</i> : I can assess competencies through indigenous narratives.	0.638	≥ .0.70	Valid/ Removed
	<i>IE_7</i> : I can align evaluation with cultural heritage practices.	0.461	≥ .0.70	Strong/ Retained
	<i>IE_8</i> : I can align evaluation with cultural heritage practices.	0.816	≥ .0.70	Valid/ Removed

Teacher Beliefs and Efficacy	<i>CCE_1</i> : I can connect classroom learning to community cultural practices		$\geq .0.70$	Weak/ Removed
	<i>CCE_2</i> : I can involve learners in cultural heritage projects.	0.792	$\geq .0.70$	Valid / Removed
	<i>CCE_3</i> : I can facilitate cultural immersion activities for learners.	0.437	$\geq .0.70$	Weak/ Removed
	<i>CCE_4</i> : I can engage learners in community-based projects that reflect cultural heritage.	0.376	$\geq .0.70$	Strong/ Retained
Implementation Challenges		0.844	$\geq .0.70$	
	<i>TBE_1</i> : I believe integrating cultural narratives enhances learner identity and efficacy.	0.822	$\geq .0.70$	Strong/ Retained
	<i>TBE_2</i> : I believe indigenous knowledge improves academic achievement	0.819		Weak/ Removed
	<i>TBE_3</i> : I believe clan myths are essential for competency development.			Weak/ Removed
	<i>IC_1</i> : I can troubleshoot difficulties in aligning indigenous knowledge with curriculum standards.			Strong/ Retained
	<i>IC_2</i> : I can identify challenges in integrating indigenous narratives into classroom practice.			Strong/ Retained
	<i>IC_3</i> : I can manage constraints when applying culturally responsive pedagogy.			Strong/ Retained
				Strong/ Retained

Note: items $\beta \geq .0.70$, were retained

Data were analysed employing maximum likelihood (ML) estimation with the NLMINB optimisation algorithm using Jamovi (2.7.14). The model included 27 free parameters and converged successfully after 33 iterations. Standard errors were computed using conventional methods. Model fit was assessed using chi-square, RMSEA, SRMR, CFI, and TLI indices. Factor loadings, variances, covariances, and intercepts were examined to evaluate construct validity and reliability. Path diagrams were generated to visually represent the relationship among the constructs and their indicators.

Model Fit

The model fit indices demonstrated that the hypothesised measurement model provided an acceptable to excellent fit across multiple indices. The chi-square test was non-significant χ^2

(17) = 18.3, $p = .368$) and RMSEA (.047), CFI (.991), TLI (.985), and IFI (.991) all exceeded recommended thresholds, indicating strong fit. Although the SRMR (.060) was slightly above the strict cutoff of .05, it remained within acceptable limits. The NFI (.893) was marginally below the .90 threshold, likely due to the small sample size. Reliability analysis confirmed internal consistency (Cronbach's $\alpha = 0.843$; McDonald's $\omega = 0.850$) as shown in Table 3. However, the overall model demonstrated robust fit across multiple indices, as shown in Table 2.

Table 2. *Goodness-of-Fit (GOF)*

Measure	Critical Value	Result	Description
χ^2	$p > 0.05$	$\chi^2 = 18.3$, $df = 17$, $p = .368$	Fit (<i>non-significant, good fit; model not different from data</i>)
RMSEA	RMSEA < 0.08	RMSEA = 0.047 (95% CI: 0.000–0.164, $p = .464$)	Fit (<i>excellent, well below cutoff</i>)
SRMR	SRMR < 0.08	SRMR = 0.060	Fit (<i>acceptable; slightly above strict cutoff but within conventional threshold</i>)
CFI	CFI > 0.97	CFI = 0.991	Fit (<i>excellent, near perfect</i>)
TLI	TLI > 0.95	TLI = 0.985	Fit (<i>excellent, near perfect</i>)
NFI	NFI > 0.90	NFI = 0.893	Fit (<i>borderline; slightly below cutoff, but acceptable in small samples</i>)
IFI	IFI > 0.95	IFI = 0.991	Fit (<i>excellent</i>)

Convergent Validity

This study assessed the convergent validity using Average Variance Extracted (AVE) and Composite Reliability (CR). As illustrated in Table 3, all constructs demonstrated acceptable CR values exceeding the recommended threshold of .70. AVE values ranged from .61 to .79, exceeding the minimum criterion of .50, indicating that the constructs explained more than half of the variance in their indicators. These results confirm adequate convergent validity.

Table 3. *Convergent Validity*

Construct	CR	AVE
Lesson Planning and Alignment	0.91	0.77
Implementation Challenges	0.88	0.71
Community & Cultural Engagement	0.81	0.61

Discriminant Validity

In addition to the Fornell-Larcker criterion, the discriminant validity was further assessed using the conceptual distinctiveness of constructs. This was supported by moderate inter-construct correlations, indicating that the latent variables represent related but distinct dimensions of IKS integration. This is shown in Table 4.

Table 4. *Latent Variable Correlations*

Construct	LPA	IC	CCE
Lesson Planning and Alignment (LPA)	0.88		
Implementation Challenges (IC)	0.31	0.84	

Community & Cultural Engagement (CCE)	0.41	0.30	0.78
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Note: Diagonal values represent $\sqrt{AVE}$

Final Model Specification

The final CFA model retained three (3) latent constructs measured by eight (8) indicators: Lesson Planning and Alignment (3 items), Implementation challenges (3 items) and Community and Cultural Engagement (2 items). Items with factor loadings below .70 were removed to improve model fit and construct reliability. The final model demonstrated excellent fit indices ($X^2(17) = 18.3$, $p = .368$; CFI = .991; RMSEA = .047; SRMR = .060), indicating that the hypothesised three-factor structure adequately represented the data.

Table 5. *Scale Reliability Statistics*

	Cronbach's α	McDonald's ω
Scale	0.843	0.850

Note: $\geq .70$ acceptable, $\geq .80$ strong, $\geq .90$ very strong

Critical Values of Factor Loadings

To assess the adequacy of factor loadings relative to sample size, critical values were consulted (Hair et al., 2021). With $N=35$, loadings above .70 are considered strong, while loadings above .50 are acceptable. Table 5 presents the critical values for interpretation.

Table 6. *Critical Values of Factor Loadings by Sample Size*

Sample Size (N)	Loading $\geq .30$	Loading $\geq .40$	Loading $\geq .50$	Loading $\geq .70$
30–50	Not acceptable	Weak	Acceptable	Strong
100	Weak	Acceptable	Strong	Very strong
200+	Acceptable	Strong	Very strong	Excellent

Note: with $N=35$, Loadings $\geq .50$ are acceptable and $\geq .70$ are strong.

However, all retained items in this study exceeded the .70 threshold, confirming strong measurement properties despite the small sample size. Table 6 presents all retained items and their critical factor loadings.

Table 7. *Critical factor loading*

Latent Construct	Item	Loading Factor (β)	Critical Loading Factor	Description
Lesson Planning and Alignment	LPA_1	0.941	$\geq .70$ = Strong	<i>Very strong indicator; consistently represents the lesson planning construct.</i>
	LPA_2	0.789	$\geq .70$ = Strong	<i>Strong loading; reliable measure of alignment.</i>
	LPA_4	0.842	$\geq .70$ = Strong	<i>Strong loading; robust measure of planning quality.</i>

Implementation Challenges	IC_2	0.844	$\geq .70 = \text{Strong}$	<i>Strong loading; reliable measure of challenges.</i>
	IC_3	0.822	$\geq .70 = \text{Strong}$	<i>Strong loading; robust indicator.</i>
	IC_1	0.819	$\geq .70 = \text{Strong}$	<i>Strong loading; reliable indicator.</i>
Community & Cultural Engagement	CCE_4	0.816	$\geq .70 = \text{Strong}$	Strong loading; reliable measure of engagement.
	TBE_1	0.792	$\geq .70 = \text{Strong}$	Strong loading; reliable indicator of teacher beliefs and efficacy.

Note: $\geq .70 = \text{Strong/ Retained}$

The reliability analysis confirmed that all retained items exceeded the critical loading threshold for small samples ($\geq .70$). This demonstrates strong construct reliability. The constructs of Lesson Planning and Alignment (LPA) and Implementation Challenges (IC) were each supported by three strong indicators, while Community and Cultural Engagement (CCE) was measured by two items that also met reliability standards. These findings provide evidence of internal consistency and support the stability of the measurement model. However, future studies should expand the item pool for community engagement to strengthen reliability further.

Variances and Covariances

Item error variances were statistically significant for most indicators, ranging from .206 to .527, confirming that each item contributed unique variance beyond the latent construct. Latent factor variances were significant: Lesson Planning and Alignment (LPA) (estimate = 1.44, $p < .001$), Implementation challenges (estimate = .56, $p < .004$) and Community and Cultural Engagement (estimate = .41, $p < .012$). Covariances among latent constructs revealed moderate positive associations between Lesson Planning and Alignment and Community and Cultural Engagement (estimate = .41, $p = .021$) and between Implementation Challenges and Community and Cultural Engagement (estimate = .30, $p = .021$). The covariances between Lesson Planning and Alignment and Implementation Challenges were positive but not statistically significant (estimate = .31, $p = .088$). Full parameter estimates, including variance, covariance and intercepts, are available upon request.

In this study, the CFA results demonstrated strong item loadings, significant latent variances, and meaningful covariances among constructs, providing evidence for the validity and reliability of the three-factor measurement model.

Path Diagram

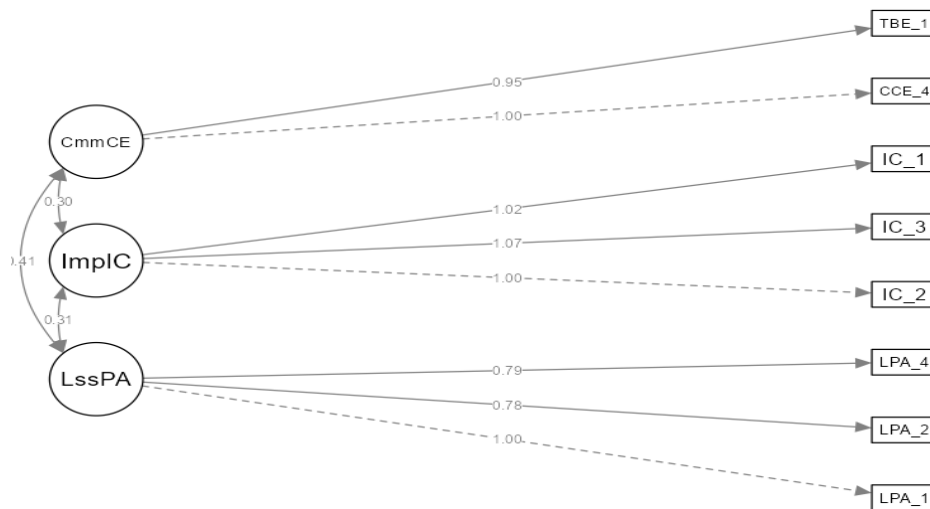


Figure 2. Path Diagram

The final measurement model shows that each latent construct is strongly represented by its observed indicators, with high standardised loadings across Lesson Planning and Alignment, Implementation Challenges, and Community and Cultural Engagement. The diagram reveals a moderate positive relationship between Lesson Planning and Alignment and Community Engagement, as well as between Implementation Challenges and Community Engagement. Although Lesson Planning and Implementation Challenges were positively related, their covariances were not statistically significant, confirming that the constructs are moderately interrelated overall.

Integrated Qualitative-Quantitative Findings

The qualitative phase identified three main themes: culturally grounded lesson design, structural and pedagogical barriers, and community engagement. These themes directly informed the development of the CFA constructs.

Lesson Planning and Alignment (LPA)

Qualitatively, the teacher uses clan myths and symbols to design lesson plans. These were confirmed quantitatively with strong factor loadings ranging from .789 to .941. This demonstrates that teachers' culturally grounded lesson design practices are consistently represented in the measurement model.

Implementation Challenges (IC)

Themes such as limited teaching resources and curriculum constraints were reflected in the IC construct. CFA results showed strong loadings of .819 to .844. This validates that structural and pedagogical barriers are significant, measurable components of IKS integration.

Community and Cultural Engagement (CCE)

Teachers' engagement with cultural activities and local communities was captured both qualitatively and quantitatively. The CFA loadings for CCE were between .0792 to .816, confirming that community participation is a core dimension of IKS integration.

Table 8. Joint Display of Integration

Qualitative Theme	Description	Quantitative Construct	CFA Results
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Cultural Design	Lesson	Use of Nyibivian clan myths and symbols (totems) in teaching	LPA	Strong Loading 0.789 - 0.941
Structural Barriers		Limited teaching resources and curricular constraints	IC	Strong Loading 0.819 - 0.844
Community Engagement		Participation in cultural activities	CCE	Strong Loading 0.792- 0.816

This joint display Table 8 demonstrates the convergence of qualitative insights with quantitative validation. This highlights that the CFA constructs are grounded in real teaching practices.

6. Discussion of Findings

This study's findings provide strong empirical support for conceptualising Indigenous Knowledge Systems (IKS) integration as a multidimensional pedagogical construct. The validated three-factor structure: Lesson Planning and Alignment, Implementation Challenges, and Community and Cultural Engagement demonstrates that effective IKS integration extends beyond curriculum content to include contextual, rational, and structural dimensions of teaching practice. Also, the strong factor loadings observed across constructs indicate that teachers' ability to embed indigenous knowledge within lesson planning is central to culturally responsive pedagogy. This finding aligns with existing scholarship emphasising the role of culturally grounded instructional design in enhancing learner engagement and identity development. Crucially, the significant association between lesson planning and community engagement suggests that meaningful integration of indigenous knowledge is inherently relational, requiring active collaboration between schools and local communities. Additionally, the identification of implementation challenges as a distinct construct highlights the structural and pedagogical barriers that constrain teachers' ability to integrate indigenous knowledge effectively. This extends previous qualitative studies by empirically demonstrating that such challenges are not peripheral but constitute a core dimension of IKS integration. Unlike prior scholarships that have largely relied on conceptual or qualitative approaches, this study provides a validated measurement framework, thereby contributing methodological rigour to the field. The development of the MIKIS instrument offers a practical tool for assessing culturally responsive teaching practices and monitoring curriculum reform initiatives. Finally, from a policy perspective, these study findings support ongoing efforts to localise curriculum content within Ghana's education system. Therefore, institutions such as the National Council for Curriculum and Assessment (NaCCA) and the Ghana Education Service may utilise the validated scale to assess teacher readiness, identify gaps in implementation, and design targeted professional development interventions for teachers. The instrument supports national policy commitments under SDG 4.7, SDG 11.4, Agenda 2063, and Ghana's Education Strategic Plan 2018-2030. Future scholarships should employ multi-group confirmatory analysis to assess measurement invariances across cultural and regional contexts to enhance the generalisability of the MIKIS instrument.

7. Implications of the Study

The study findings have important implications for curriculum development, teacher education, and educational policy. First, the validated MIKIS provides a practical tool for assessing teachers' competence in integrating indigenous knowledge into classroom practice. Second, the identification of Lesson Planning and Alignment, Implementation Challenges and Community and Cultural Engagement as key dimensions suggests that teacher preparation programmes should explicitly train educators to connect curriculum content with local cultural resources and community knowledge. Third, stakeholders in education, such as NaCCA and the Ghana Education Service, may use the instrument to monitor curriculum implementation, identify gaps in teacher readiness, and design targeted professional development interventions. Finally, the study reinforces the view that culturally responsive pedagogy and community-based knowledge are central to sustainable and culturally relevant basic education.

8. Contribution of the Study

This study makes three major contributions to scholarship and practice. Conceptually, it advances culturally responsive pedagogy by showing that indigenous knowledge integration can be conceptualised as a multidimensional pedagogical construct. Methodologically, it contributes a validated and reliable scale measuring teachers' indigenous knowledge integration practices in basic education. Practically, it offers evidence that can inform curriculum reform, teacher training, and policy evaluation in Ghana and other contexts where indigenous knowledge remains underrepresented in formal schooling.

9. Limitations and Recommendations for Future Studies

The study considered several limitations, including the small sample size (local sample), that limit generalisability and stability of the parameter estimates. Also, the study was conducted within a single clan and municipality, which may not represent broader regional or national contexts. The use of self-reported measures may introduce social desirability bias; future studies should include classroom observation. Moreover, the cross-sectional design does not allow for causal interpretation or assessment of changes over time; longitudinal studies should be used in future studies. Finally, the community and Cultural engagement construct measured only two indicators; future studies should expand the item pool to enhance measurement precision. Future studies should validate the instrument using larger and more diverse samples, conduct multi-group CFA to examine measurement invariance, and explore structural relationships between indigenous knowledge integration and student learning outcomes.

10. Conclusion

To assess Ghana's basic education teachers' practices in integrating Indigenous Knowledge Systems (IKS), this study developed and validated a multidimensional instrument. The results of the Confirmatory Factor Analysis (CFA) supported a three-factor model comprising Lesson Planning and Alignment, Implementation Challenges, and Community and Cultural Engagement. The model showed good fit, reliability, and evidence of convergent and discriminant validity, indicative that the scale is both psychometrically sound and theoretically grounded. The findings confirm the importance of culturally responsive instructional planning and the use of community-based knowledge, consistent with culturally responsive pedagogy. Similarly, the presence of a distinct implementation challenges dimension highlights the need for institutional support, teaching resources, and professional development to facilitate effective integration. The instrument provides a practical tool for teacher education, capacity building, and monitoring the implementation of culturally relevant curriculum reforms that

align with national and global education demands. Future studies should validate the model using larger and more diverse samples to examine the relationship between IKS integration and student learning outcomes. Finally, this study contributes to evidence-based efforts in promoting culturally sustainable education.

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