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# Investigating Pre-Service Teachers' Perceptions and Attitudes on the Integration of Indigenous Knowledge in Life Sciences Curriculum: A Qualitative Approach

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**Keywords:**
Curriculum integration, Inclusive education, Indigenous knowledge (IK), Life sciences curriculum, PGCE pre-service teachers education.

**Abstract.** This paper investigates pre-service Life Sciences teachers' perceptions, attitudes, and readiness to integrate Indigenous Knowledge (IK) into the Life Sciences curriculum in the Further Education and Training (FET) phase in South Africa. It aims to explore their preparedness after formal exposure to relevant coursework and the challenges they perceive in doing so. A qualitative research approach was employed, using semi-structured interviews with a purposive sample of 46 Postgraduate Certificate in Education (PGCE) pre-service teachers at a South African university. Data were analyzed thematically to uncover patterns and insights related to attitudes, IK understanding, institutional support and pedagogical readiness. Findings reveal that while Life Sciences pre-service teachers recognize the educational and cultural value of IK integration, they feel inadequately prepared to apply it in their teaching practices. Major barriers include insufficient training, a lack of contextual examples in teaching materials, and minimal curriculum guidance. Despite these challenges, participants strongly support the integration of IK to promote cultural relevance and inclusivity in Life Sciences education. The study concludes that without targeted training and curricular support, efforts to integrate IK meaningfully into Life Sciences education may remain ineffective. Teacher education programs must intentionally incorporate structured content, methodologies, and resources on Indigenous Knowledge to improve pedagogical confidence and foster the decolonization of the Life Sciences curriculum. These insights are crucial for educators, curriculum developers, and policymakers aiming to bridge cultural and epistemological gaps in Life Sciences education.

## 1. INTRODUCTION

In recent years, the call to decolonize Life sciences education in South Africa has intensified. The purpose is to urge curriculum planners and Life Sciences educators to recognize and incorporate Indigenous Knowledge (IK) epistemologies into classroom teaching and learning practices. Within science education, this integration is critical, as the dominance of scientific Western epistemologies often overshadows the local cultural knowledge in the classrooms. The Life Sciences curriculum in the Further Education and Training (FET) phase serves as a fertile ground to introduce this transformation. This study seeks to investigate the perceptions and attitudes of PGCE pre-service Life Sciences teachers toward the integration of IK, with a specific focus on their preparedness, challenges encountered, and perceived value of such integration. Understanding these factors is significant for Life sciences education lecturers to inform teacher education programs and curriculum development that promote inclusivity, contextually relevant, and culturally responsive Life Sciences education.

## 2. THEORETICAL FRAMEWORK

The inclusion of IK in Life Sciences education is rooted in decolonial theory, which advocates for the validation of diverse epistemologies including indigenous ways of knowing. Researchers advocate that incorporating IK can enhance learner engagement, provide contextual relevance, promote relational learning and develop them cognitively (El Yazidi & Rijal, 2024). Previous studies like the one authored by Buthelezi, (2025), shows that while pre-service Life Sciences educators generally support IK inclusion, many feel ill-equipped due to insufficient teacher training, IK tools and relevant materials to implement the strategy.

This theoretical framework posits that colonial legacies have systematically marginalized indigenous knowledge epistemologies. Often rendering them inferior within formal education and training. In the context of Life Sciences, a discipline traditionally rooted in Eurocentric scientific paradigms, integrating IK represents a deliberate shift towards epistemic justice. This approach upholds learners lived experiences, cultural practices, and natural environment understandings of Indigenous communities, viewing them not as supplementary to teaching, but as legitimate and contextually rich bodies of knowledge. In this way, pre-service educators can foster more inclusive, relevant and transformative Life Sciences education that aligns with learners' identities and socio-cultural realities, especially in postcolonial societies like South Africa. Recent scholarship, such as the work of Sitsha, (2023), emphasizes the importance of moving beyond binary oppositions between Western and African knowledge systems, advocating for a more integrated and holistic teaching approaches to the ways of knowing.

## 3. LITERATURE REVIEW

The South African Life Sciences CAPS curriculum policy (DBE, 2011) encourages IK integration, yet practical implementation remains inconsistent. Research indicates that teacher attitudes, institutional support, and curriculum design significantly influence the success of such integration. Therefore, understanding pre-service teachers' experiences and attitudes becomes imperative in addressing these gaps. The study reviewed a comprehensive synthesis of recent studies that attempt to address key themes

related to the integration of Indigenous Knowledge (IK) into Life Sciences education in South Africa.

### 3.1. Understanding of Indigenous Knowledge (IK)

Indigenous Knowledge encompasses the cumulative body of teaching strategies, everyday practices, techniques, tools, intellectual resources, explanations, beliefs, and values developed over time within specific local communities, independent of external Westernized influences. In the South African educational context, this knowledge reflects the lived experiences, cultural practices, and ecological understandings of Indigenous communities (Ahanonye, Otulaja, Risenga & Dukhan, 2024).

Despite policy mandates encouraging the inclusion of IK in curricula, many Life sciences educators lack an understanding of how to incorporate it in their teaching practices as well as its significance. For instance, a study by Ahanonye, (2021) revealed that while some teachers integrate IK based on personal experiences, there exists a general uncertainty about its definition and application in Life Sciences classrooms. This gap emphasizes the need for clearer IK integration guidelines and pre-service teacher training to enhance their understanding and effective utilization of IK in classroom practices.

### 3.2. Attitudes Towards the Integration of IK

Educators' attitudes play an important role in the successful incorporation of IK into the Life Sciences curriculum. Research indicates teacher perceptions, ranging from positive acknowledgment of IK's value to scepticism about its relevance in Life scientific education.

For instance, studies conducted by authors Ramnarain & Mavuru (2021) highlighted that while educators recognize the importance of incorporating African Indigenous Knowledge Systems (AIKS) into Life Sciences education, they often feel ill-equipped due to insufficient training and tools. Similarly, Buthelezi (2025) found that some teachers, despite personal familiarity with indigenous knowledge, they struggle with its formal incorporation into Life Science classroom teaching practices due to a lack of clear instructional strategies. These findings point to the fact that enhancing educators' confidence and competence in integrating IK requires targeted professional development in a form of trainings and institutional support in reforming methodology training modules.

### 3.3. Classroom Practices and Pedagogical Readiness

Effective integration of IK into classroom practices necessitates pedagogical readiness and adaptability. Researchers Sitsha (2023); Ogegbo & Ramnarain (2024) conducted studies revealing that Life sciences teachers often lack the training to merge IK with scientific concepts effectively. The studies emphasized that teachers' cultural backgrounds influence their approach to IK integration, highlighting the need for culturally responsive teaching strategies.

Furthermore, a systematic review by the African Journal of Research in Mathematics, Science and Technology Education (2024) identified several pedagogical practices conducive to IK integration, including argumentative class discussions that encourage integration and critical thinking, contextualized instructional tools that reflects Indigenous Knowledge, collaboration with Indigenous knowledge societies especially knowledge keepers and elders, lastly, exposure to experiential learning activities, such as cultural field trips to conduct research indigenous communities. These classroom practices not only enrich the learning experience of learners but also foster a deeper understanding and appreciation of ancestral wisdom viewpoints.

### 3.4. Institutional and Curriculum Support

Higher institutional backing and co-curriculum design with indigenous communities are critical for the successful integration of IK in Life Sciences curriculum. While South African educational policies, such as the Curriculum and Assessment Policy Statement (CAPS), advocate for the inclusion of IK, practical implementation often falls short due to inadequate support structures. Ogegbo & Ramnarain (2024) noted that educators require more explicit guidance and resources from the Department of Basic Education to effectively incorporate local knowledge into their classroom lessons. Similarly, a study by Bhaw, De Beer & Kriek, (2025) emphasized that teacher professional development programs must address the epistemological tensions between Western science and Indigenous knowledge to facilitate meaningful integration.

These insights highlight the necessity for education systemic revision, including curriculum reforms, IK resource allocation, and ongoing pre-service teachers' professional development, to support them in this.

### 3.5. Perceived Challenges and Opportunities

Sitsha (2023) advocates that educators face several challenges in integrating IK, including lack of training and IK resource materials for guidance, time constraints within the overloaded curriculum, limited access to Indigenous knowledge holders due to disconnection between formal education and these societies, perceived conflicts between scientific and Indigenous worldviews when teaching the content.

Despite these above-mentioned obstacles, opportunities exist to enrich Life Sciences education through IK integration. Tripon, (2024) advocates for the use of storytelling and local narratives to make learning more relevant and engaging for students in rural South Africa. Additionally, leveraging technology to digitize IK resources can enhance accessibility and preservation of Indigenous knowledge. Addressing these challenges requires a multifaceted approach, including CAPS curriculum policy reforms, engagement with Indigenous communities and investing in pre-service educator training and IK resources.

## 4. RESEARCH APPROACH

A qualitative research design was chosen to gain deep insights into lived the experiences and perceptions of pre-service teachers. The study involved semi-structured interviews with 46 PGCE Life Sciences students at a South African university. Participants were selected through purposive sampling to ensure relevance and richness of data (Nyimbili & Nyimbili, 2024).

Ethical clearance was obtained, and teacher participants gave informed consent (Mourao, 2021). Data was collected through questionnaire, and analysed using thematic analysis, following Braun and Clarke's six-step approach Naeem, Ozuem, Howell, & Ranfagni, (2023). This method is relevant to the current study as it enabled the identification of recurring themes related to IK integration by pre-service teachers as follows:

The Naeem et al. (2023) theme analysis technique is referred to be "systematic" due to its orderly, organized approach to research data interpretation. A thorough grasp of the facts is the outcome of each step building on the one before it. The findings are more consistent and reproducible because to this systematic approach, which also makes it possible to make direct links between the facts, interpretation, and conclusions. This methodical, disciplined technique guarantees thoroughness and reduces the possibility of prejudice.

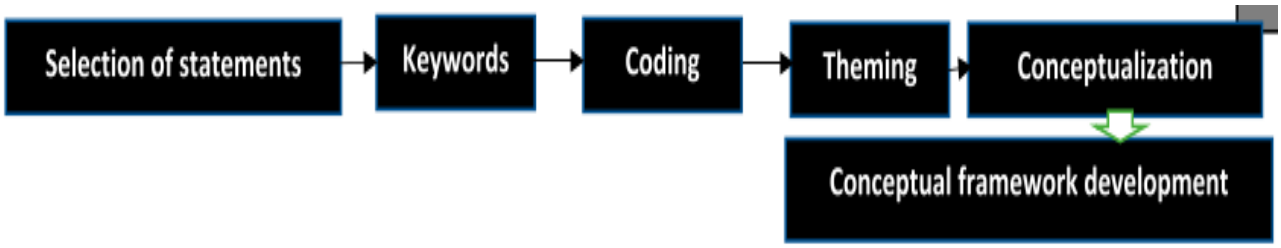


Figure 1: Braun and Clarke's six-step thematic approach.

Step 1: Transcription, Data Familiarization, and Quotation Selection

The process of theme analysis begins with this step. It entails transcribing material and becoming acquainted with it. Scholars go deeply into the material to identify key passages and emerging ideas. After that, they choose quotations that vividly depict the data and suitably capture a range of perspectives and trends relevant to the study's goals.

Step 2: Choosing Keywords

In this stage, the data, whether from focus groups, interviews, or visual materials is closely examined. Keywords are defined by researchers as recurrent patterns, phrases, or visual components. Automatically drawn from the information provided, these key phrases capture the lived experiences and viewpoints of those who took part.

Step 3: Writing code

The third phase involves assigning codes, brief phrases or words to data segments that best convey the main idea, importance, or subject of the data. This process helps uncover components linked to the study topics and simplifies complicated textual material by turning it into a theoretical form. In coding, keywords are crucial since they serve as the foundation of the analysis and aid in transforming unstructured data into coherent, digestible chunks.

Step Four: Developing a Theme

The process of theme creation is grouping codes into meaningful categories to spot trends and connections that provide information about the research subject. In this stage, the researcher develops themes to go from a thorough examination of codes and categories to a more abstract interpretation. These themes include patterned meanings that connect the data and study questions, making them more than just recurrent components.

Step 5: Conceptualization by Interpreting Themes, Codes, and Keywords

In the conceptualization process, ideas that emerge from the data are understood and defined. After identifying social patterns, researchers hone them into definitions that support their findings. They make use of tools such as models or diagrams to comprehend the connections between these ideas. These definitions' quality is evaluated according to their contribution to theory and practice, clarity, precision, dependability, and application.

Step 6: Creation of a Conceptual Framework

A conceptual model is created as the last phase in the theme analysis process. Creating a distinctive representation of the data is part of this process, which is frequently directed by accepted ideas. In addition to addressing the research objectives, the model highlights the study's contribution to knowledge. The conclusion of the analysis is represented by this stage, which summarizes all the conclusions and revelations drawn from the data.

## 5. PRESENTATION OF FINDINGS

### 5.1. Understanding and Value of Indigenous Knowledge

90% teacher participants acknowledged that IK holds valuable insights into environmental sustainability, health practices, and ecological relationships. They believed IK can enrich the Life Sciences curriculum and foster cultural pride among learners. Only 10% participants were neutral about the understanding and value of indigenous knowledge in their classroom practices.

### 5.2. Attitudes Toward IK integration in Life Sciences

All pre-service teachers expressed generally positive attitudes toward IK inclusion constituting to 100%. They all recognized its role in making Life Sciences education more relatable and inclusive but also noted that IK marginalization in formal training institutes affects their confidence in delivering an integrated content.

### 5.3. Pedagogical Readiness and Classroom Practice

Many teacher participants, about 60% admitted feeling unprepared to teach IK effectively due to a lack of training, sample materials and practical examples. Some (30%) expressed uncertainty about how to balance scientific content with traditional knowledge, while 10% were worried about misrepresentation of IK to learners.

### 5.4. Institutional and Curriculum Barriers

50% participants echoed for a limited guidance in teacher education programs and the absence of IK in Life Sciences textbook contents. They highlighted this as one of the significant challenges they are facing. 40% teacher participants called for explicit curriculum directives, while 10% urged for institutional support for IK integration.

## 5.5. Opportunities for Inclusive and Culturally Relevant Teaching

Despite challenges, all participants (100%), viewed IK integration as a powerful tool to connect Life Sciences with learners lived experiences (relational learning). They further suggested that its inclusion could improve learner engagement and promote respect for cultural diversity.

These findings were analysed and distilled into the following keywords, codes and themes as suggested by Naeem et.al., (2023).

## 5.6. Thematic Analysis of Findings

Table 1: Analysis of findings into the keywords, codes and themes as adapted from Naeem et.al., (2023).

| Selection of statements | Keywods | Codes | Themes |
|---|---|---|---|
| "I have a *clear understanding* of what Indigenous Knowledge entails in the context of Life Sciences".<br><br>"*Indigenous Knowledge is as valuable as Western* scientific knowledge in understanding the natural world".<br><br>"I can *identify examples of Indigenous Knowledge relevant* to Life Sciences topics".<br><br>"I have been *exposed to Indigenous Knowledge* by my Life science education lecturer during training".<br><br>"I believe Indigenous Knowledge systems are based *on empirical observation and valid reasoning"*. | *clear understanding of IK*<br><br>*IK is as valuable as Western*<br><br>*Identify examples of Indigenous Knowledge relevant*<br><br>*Exposed to IK by lecturer during training*<br><br>*IK on empirical observation and valid reasoning"* | *Understanding*<br><br>*Valuable*<br><br>*Relevant examples*<br><br>*Exposed to training*<br><br>*Empirical and reasoning* | Understanding and value of indigenous knowledge |
| "I am *interested in learning more* about Indigenous Knowledge systems".<br><br>"I feel *confident about incorporating Indigenous Knowledge* into my Life Sciences lessons".<br><br>"Integrating IK will make *Life Sciences more relatable to learners* from diverse backgrounds".<br><br>"I view IK integration to promote *cultural inclusivity* in the Life sciences classroom".<br><br>"I believe Indigenous Knowledge could *enrich scientific understanding* in Life Sciences". | *interested in learning more*<br><br>*confident about incorporating IK*<br><br>*Life Sciences more relatable to learners*<br><br>*Cultural inclusivity*<br><br>*enrich scientific understanding* | *Interested*<br><br>*Confident*<br><br>*Relatable*<br><br>*Inclusive*<br><br>*enrichment* | Attitudes toward integration |
| "I *know how to plan a lesson* that integrates Indigenous Knowledge with the Life Sciences curriculum".<br><br>"I *have access to resources* that help me incorporate IK in my teaching".<br><br>"I *use case studies* or practical examples that include Indigenous Knowledge during teaching practice".<br><br>"I *collaborate with my peers* or lecturer (mentors) on integrating IK into lessons".<br>"I adapt *my teaching strategies to include diverse knowledge systems,* including Indigenous perspectives". | *know how to plan an IK lesson*<br><br>*have access to IK resources*<br><br>*use IK case studies*<br><br>*collaborate with my peers*<br><br>*my teaching strategies include diverse knowledge* | *Lesson plan*<br><br>*Access*<br><br>*Case studies*<br><br>*Collaborations*<br><br>*Teaching strategies* | Pedagogical readiness and classroom practice |
| "The Life Sciences c*urriculum allows space for Indigenous Knowledge integration* in CAPS specific Aims" | *Curriculum allows space for IK integration*<br><br>*emphasizes the importance of* | *Flexible curriculum*<br><br>*IK significance* | Institutional and curriculum barriers |

| | | | |
|---|---|---|---|
| "My Life sciences teacher education program *emphasizes the importance of integrating IK*".<br><br>"There is *institutional encouragement* to include IK in our teaching practices".<br><br>"I receive *support from mentor lecturers* in using IK in Life sciences".<br><br>"Assessment tools used in Life Sciences reflect inclusion of Indigenous perspectives". | *integrating IK*<br>*institutional encouragement*<br><br>*receive support from mentor lecturers*<br><br>*tools reflect IK inclusion* | *Institutional support*<br><br>*Lecturers support*<br><br>*Samples of assessment* | |
| "I find it *difficult to come up with or access* authentic Indigenous Knowledge *sources".*<br><br>"I worry about *misrepresenting or appropriating Indigenous Knowledge*".<br><br>"Learners might *not take IK seriously* in a Life sciences classroom".<br><br>"Integrating *IK requires more time and planning* than I am usually allowed by CAPS curriculum".<br><br>"Despite the challenges, I *see long-term benefits in integrating Indigenous Knowledge* into teaching". | *difficult to access and create IK sources*<br><br>*misrepresenting Indigenous Knowledge*<br>*not take IK seriously*<br><br>*IK requires more time and planning*<br><br>*see long-term benefits in integrating Indigenous Knowledge* | *IK inaccessibility*<br><br>*IK misrepresentations*<br><br>*Incorporated superficially*<br>*More time on planning*<br><br>*Long term benefits* | Opportunities for inclusive and culturally relevant teaching |

## 6. DISCUSSION OF FINDINGS

The study presents a detailed examination of teachers' perceptions, attitudes and experiences related to the integration of Indigenous Knowledge (IK) into Life Sciences classroom practices. The findings can be synthesized and discussed under the following key themes:

### 6.1. Understanding of Indigenous Knowledge (IK)

High recognition (90%) among teacher participants indicates a broad consensus that IK offers valuable insights in areas such as environmental sustainability, traditional health practices, and understanding ecological systems. Teachers also emphasized the cultural significance of IK, highlighting its potential to enrich Life Sciences education and foster cultural pride among learners. Only a small minority (10%) remained neutral, suggesting a general trend of acknowledgment, though possibly lacking full engagement or confidence. In the South African educational context, this knowledge reflects the lived experiences, cultural practices, and ecological understandings of Indigenous communities (Ahanonye, Otulaja, Risenga & Dukhan, 2024). A study by Ahanonye, (2021) revealed that while some teachers integrate IK based on personal experiences, there exists a general uncertainty about its definition and application in Life Sciences classrooms. This gap emphasizes the need for clearer IK integration guidelines and pre-service teacher training to enhance their understanding and effective utilization of IK in classroom practices.

### 6.2. Attitudes Towards the Integration of IK in Life Sciences

The study reports 100% positive attitudes toward integrating IK into Life Sciences, showcasing strong support among pre-service teachers. This finding was supported by the studies that pointed that educators' attitudes play an important role in the successful incorporation of IK into the Life Sciences curriculum. Research indicates teacher perceptions, ranging from positive acknowledgment of IK's value. For instance, studies conducted by authors Ramnarain & Mavuru (2021) highlighted that while educators recognize the importance of incorporating African Indigenous Knowledge Systems (AIKS) into Life Sciences education, they often feel ill-equipped due to insufficient training and tools.

Teachers further viewed IK to make Life Sciences more relatable, inclusive, and contextually relevant. However, they also pointed out that the marginalization of IK in formal education such as its absence in teacher training programs diminishes their confidence in implementing IK-based teaching strategies effectively. Similarly, Buthelezi (2025) found that some teachers, despite personal familiarity with indigenous knowledge, they struggle with its formal incorporation into Life Science classroom teaching practices due to a lack of clear instructional strategies. These findings point to the fact that enhancing educators' confidence and competence in integrating IK requires targeted professional development in a form of trainings and institutional support in reforming methodology training modules.

### 6.3. Classroom Practices and Pedagogical Readiness

A majority (60%) admitted feeling pedagogically unprepared to teach IK, citing the lack of training, resources, and examples. 30% of participants felt uncertain about integrating scientific and traditional knowledge, reflecting a common challenge in interdisciplinary teaching. A smaller portion (10%) feared misrepresenting IK, showing a concern for cultural sensitivity and

accuracy. According to the study effective integration of IK into classroom practices necessitates pedagogical readiness and adaptability. Researchers such as Sitsha (2023); Ogegbo & Ramnarain (2024) conducted studies revealing that Life sciences teachers often lack the training to merge IK with scientific concepts effectively. The studies emphasized that teachers' cultural backgrounds influence their approach to IK integration, highlighting the need for culturally responsive teaching strategies. Furthermore, a systematic review by the African Journal of Research in Mathematics, Science and Technology Education (2024) identified several pedagogical practices conducive to IK integration, including argumentative class discussions that encourage integration and critical thinking, contextualized instructional tools that reflects Indigenous Knowledge, collaboration with Indigenous knowledge societies especially knowledge keepers and elders, lastly, exposure to experiential learning activities, such as cultural field trips to conduct research indigenous communities. According to the current study, these classroom practices not only enrich the learning experience of learners but also foster a deeper understanding and appreciation of ancestral wisdom viewpoints.

### 6.4. Institutional and Curriculum Support

50% of teachers criticized the lack of guidance and resources in current teacher education and Life Sciences textbooks. 40% advocated for explicit curriculum mandates to support IK inclusion. 10% called for greater institutional support, highlighting the need for systemic changes rather than relying solely on teacher initiative. The study advocates that Higher institutional backing and co-curriculum design with indigenous communities are critical for the successful integration of IK in Life Sciences curriculum. While South African educational policies, such as the Curriculum and Assessment Policy Statement (CAPS), advocate for the inclusion of IK, practical implementation often falls short due to inadequate support structures. These findings were further supported by Ogegbo & Ramnarain (2024) who noted that educators require more explicit guidance and resources from the Department of Basic Education to effectively incorporate local knowledge into their classroom lessons. Similarly, a study by Bhaw, De Beer & Kriek, (2025) emphasized that teacher professional development programs must address the epistemological tensions between Western science and Indigenous knowledge to facilitate meaningful integration. These insights highlight the necessity for education systemic revision, including curriculum reforms, IK resource allocation, and ongoing pre-service teachers' professional development, to support them in this.

### 6.5. Perceived Challenges and Opportunities for Culturally Appropriate Teaching

Despite the challenges, there was a strong belief among all participants that IK can enhance learner engagement through relational and culturally relevant learning. Teachers identified IK as a bridge between formal science education and learners lived experiences, promoting respect for cultural diversity and inclusivity in the classroom. These findings were echoed by Sitsha (2023) who advocates that educators face several challenges in integrating IK, including lack of training and IK resource materials for guidance, time constraints within the overloaded curriculum, limited access to Indigenous knowledge holders due to disconnection between formal education and these societies, perceived conflicts between scientific and Indigenous worldviews when teaching the content

## 7. CONCLUSION

This study emphasizes the importance of preparing pre-service teachers to integrate Indigenous Knowledge into Life Sciences classroom teaching practices. While teachers' attitudes are largely positive, a lack of training and institutional support hampers the practical implementation of the strategy. For IK integration to be meaningful and sustainable, pre-service teacher education programs must provide targeted training in their training modules in a form of resources and IK curricular guidance.

## 8. STUDY PRACTICAL IMPLICATIONS

The findings reflect a widespread positive disposition toward Indigenous Knowledge among pre-service teachers but reveal significant gaps in pre-service teacher training, IK integrated lesson samples and institutional support. The desire to implement IK is evident from the findings, but education systemic barriers ought to be addressed to move from aspiration to effective practice. Life Sciences curriculum developers, pre-service teacher training programs and policymakers are called upon to provide training and IK pedagogical sample materials, integrate IK explicitly into CAPS curricula and Life Sciences prescribed textbooks and offer an ongoing institutional support to ensure that IK is meaningfully integrated in the curriculum.

The findings have direct implications for Life Sciences curriculum developers, pre-service educators and CAPS curriculum policymakers. Structured teacher training modules should be IK embedded within teacher training programs, accompanied by practical examples as samples and formal assessment strategies for indigenous epistemology. Schools and universities should foster partnerships with Indigenous communities to develop contextually relevant IK teaching materials. These steps are essential to support the decolonization of Life Sciences education and promote epistemological diversity in the classroom.

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