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**Students' Perceptions of Learning Ecology through Indigenous
Knowledge in Secondary Schools in Dodoma, Tanzania**



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Students' Perceptions of Learning Ecology through Indigenous Knowledge in Secondary Schools in Dodoma, Tanzania



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Abstract

Purpose: This study explored secondary-school students' perceptions of learning ecology through Indigenous Knowledge (IK) in Dodoma, Tanzania, addressing a gap in the literature: despite growing recognition of IK as a resource for contextualizing science education, limited evidence explains how students themselves experience its use in ecology lessons.

Methodology: This paper reports the student-focused component of a qualitative multiple-case study involving 32 Form Six Biology students drawn from four secondary schools in Dodoma. Data were collected through focus group discussions, classroom observations, and documentary review, and were analyzed using reflexive thematic analysis. The interpretation was guided by Constructivist Learning Theory, which treats students' community-based environmental experiences as prior knowledge through which they construct ecological understanding.

Findings: Students perceived IK as a valuable instructional resource: familiar examples drawn from farming, seasonal observation, and environmental conservation clarified ecological concepts, increased interest and participation, connected classroom learning to real-life practices, and promoted appreciation of community knowledge. At the same time, students reported inconsistent implementation of IK across lessons, limited instructional time devoted to it, and weak explanation of the relationship between Indigenous and scientific knowledge. The documentary review corroborated this pattern, showing limited explicit curriculum guidance for systematic IK integration into ecology teaching.

Unique Contribution to Theory, Practice, and Policy: Theoretically, the study extends Constructivist Learning Theory into an underrepresented empirical setting by demonstrating, from students' own perspectives rather than teachers', For practice, the findings give ecology and biology teachers concrete grounds for using farming, seasonal, and conservation-related examples not simply as illustrative content but as deliberate bridges to formal ecological concepts, and signal that doing so consistently, rather than occasionally, can support student interest, participation, and perceived relevance. For policy, the study provides context-specific evidence that curriculum authorities and teacher-training institutions in Tanzania can draw on to strengthen teacher preparation and to develop clearer, more explicit curriculum guidance for the systematic integration of indigenous and scientific knowledge in ecology and biology syllabi.

Keywords: *Indigenous Knowledge, Ecology Education, Students' Perceptions, Science Education, Secondary Schools, Tanzania.*

JEL Classification: I21, I28.

INTRODUCTION

The integration of Indigenous Knowledge (IK) into formal education has gained increasing attention as educators seek to make learning more relevant, inclusive, and responsive to local contexts (Greenall & Bailey, 2022; Latip et al., 2024). Indigenous Knowledge refers to the knowledge, skills, values, and practices that communities develop through long-term interaction with their environments (Berkes, 2018). In science and environmental education, IK can illuminate ecological processes, biodiversity conservation, natural-resource management, weather prediction, and sustainable livelihoods (Oando, 2024; Thompson et al., 2020).

Scholars have emphasized the importance of incorporating Indigenous Knowledge into science education to enhance students' understanding of scientific concepts and strengthen the connection between classroom learning and real-life experiences (Aikenhead & Ogawa, 2007; Greenall & Bailey, 2022). The integration of Indigenous Knowledge has been associated with improved learner engagement, contextualized learning, and recognition of diverse knowledge systems within educational settings (Latip et al., 2024; Thompson et al., 2020). Such approaches are particularly relevant in ecology education because learners must understand interactions between organisms and their environments and apply ecological knowledge to environmental challenges (Berkes, 2018; Oando, 2024).

In Tanzania, concerns about curriculum implementation highlight the need to examine how ecology teaching connects formal scientific perspectives with local ecological knowledge and community experience. Komba and Shukia (2023) identified a gap between intended and enacted curricula, although their study addressed 21st-century skills rather than IK in ecology. Communities possess environmental knowledge related to farming, seasonal prediction, conservation, and resource management that can contextualize ecological ideas (Berkes, 2018; Oando, 2024). Limited inclusion of such knowledge in classroom materials and instruction may reduce students' opportunities to connect scientific concepts with everyday environmental realities.

Previous studies have reported positive outcomes associated with Indigenous Knowledge integration, including improved student participation, stronger cultural identity, and enhanced conceptual understanding (Greenall & Bailey, 2022; Latip et al., 2024; Segopotse, 2021). However, much of this work has addressed undergraduate biology, general science education, or contexts outside Tanzania, while Tanzanian curriculum research has paid limited attention to students' perceptions of IK in secondary-school ecology classrooms (Greenall & Bailey, 2022; Komba & Shukia, 2023; Segopotse, 2021). Therefore, this study explored students' perceptions of learning ecology through Indigenous Knowledge in secondary schools in Dodoma, Tanzania, with the aim of informing more meaningful, culturally relevant, and context-based science education.

Statement of the Problem

A growing body of research links the integration of Indigenous Knowledge (IK) into science teaching to positive learning outcomes, including improved student participation, stronger

cultural identity, and enhanced conceptual understanding (Greenall & Bailey, 2022; Latip et al., 2024; Segopotse, 2021). These findings suggest that IK is not merely a cultural add-on to science instruction but a pedagogical resource capable of making abstract scientific concepts more accessible and meaningful to learners.

However, this evidence base has three specific limitations that leave an important gap unaddressed. First, much of it comes from undergraduate or general science education settings rather than secondary-school classrooms, where students' cognitive and cultural relationships to content differ substantially (Greenall & Bailey, 2022; Segopotse, 2021). Second, the studies are concentrated in contexts outside Tanzania, so their conclusions about how IK is received by learners cannot be assumed to transfer to Tanzanian classrooms, where the specific ethnic knowledge systems, curriculum structure, and language of instruction differ markedly. Third, and most directly relevant to this study, limited attention in the literature reviewed here is given to ecology specifically, a subject in which IK (on land use, seasonal change, biodiversity, and resource management) has direct pedagogical relevance (Latip et al., 2024).

Within Tanzania itself, curriculum research has so far concentrated on structural and policy-level questions, for example, how far the basic education curriculum builds generic competencies such as problem-solving and critical thinking (Komba & Shukia, 2023), rather than on how IK is experienced by students in specific science subjects. As a result, the literature reviewed here provides limited empirical evidence of how Tanzanian secondary-school students themselves perceive, engage with, or make sense of IK when it is used to teach ecology, even though these are precisely the perceptions that can influence the effectiveness of IK integration in practice.

This gap matters because curriculum reforms that promote IK integration without evidence of how students actually experience it in the classroom risk being culturally well-intentioned but pedagogically untested. Therefore, this study explored students' perceptions of learning ecology through Indigenous Knowledge in secondary schools in Dodoma, Tanzania, with the aim of generating context-specific evidence to inform more meaningful, culturally relevant, and effective science education.

Purpose of the Study

The purpose of this study was to explore secondary-school students' perceptions of learning ecology through Indigenous Knowledge (IK) in Dodoma, Tanzania.

Objectives of the Study

1. To explore students' perceptions of the value of Indigenous Knowledge as an instructional resource in learning ecology.
2. To examine the challenges students experience regarding the implementation of Indigenous Knowledge in ecology lessons.

3. To assess the extent to which the school curriculum provides guidance for the integration of Indigenous Knowledge into ecology teaching.

Research Questions

1. How do students perceive the value of Indigenous Knowledge as an instructional resource in learning ecology?
2. What challenges do students experience regarding the implementation of Indigenous Knowledge in ecology lessons?
3. To what extent does the school curriculum provide guidance for the integration of Indigenous Knowledge into ecology teaching?

LITERATURE REVIEW

Indigenous Knowledge has increasingly been recognized as an important resource for improving the relevance and effectiveness of science education (Berkes, 2018; Thompson et al., 2020). It represents a cumulative body of environmental understanding developed through continuous interaction between communities and their natural environments (Berkes, 2018). In ecology education, this knowledge offers practical insights into biodiversity conservation, resource management, weather prediction, and sustainable environmental practices (Oando, 2024; Thompson et al., 2020).

Studies have shown that integrating Indigenous Knowledge into science classrooms enhances contextualized learning by connecting scientific concepts with learners' lived experiences (Aikenhead & Ogawa, 2007; Thompson et al., 2020). Greenall and Bailey (2022) further argue that Indigenous Knowledge contributes to inclusive learning environments by recognizing diverse knowledge systems and promoting students' appreciation of local environmental practices. Accordingly, Indigenous Knowledge is best treated as a valuable complement to formal scientific knowledge rather than as a replacement for it (Aikenhead & Ogawa, 2007; Greenall & Bailey, 2022).

Student-focused studies generally report positive responses to IK integration (Latip et al., 2024; Segopotse, 2021). Latip et al. (2024) found that local and Indigenous knowledge can improve engagement and conceptual understanding by linking science content to familiar contexts. Segopotse (2021) similarly reported that secondary-school learners valued the cultural relevance and practical applications of IK in Life Sciences, although some remained skeptical when formal assessment privileged Western science. Greenall and Bailey (2022) also observed that meaningful inclusion can strengthen belonging and appreciation of diverse knowledge systems. Together, these studies show that students' perceptions depend not only on the presence of IK but also on how clearly and respectfully teachers connect it to scientific content.

Furthermore, IK integration can strengthen learners' cultural identity and sense of belonging by recognizing community knowledge as a legitimate classroom resource (Ladson-Billings, 2021; Segopotse, 2021). In environmental education, local examples can make ecological

problems more immediate and motivate students to participate in discussions about their surroundings (Greenall & Bailey, 2022; Oando, 2024). These benefits require more than occasional references: teachers must explain the relationship between community practices and scientific concepts so that IK functions as an integrated knowledge resource rather than as an isolated anecdote (Aikenhead & Ogawa, 2007; De Beer & Van Wyk, 2021).

Research also identifies conditions that shape students' perceptions. Aikenhead and Ogawa (2007) argue that learners navigate different knowledge traditions most successfully when teachers explicitly mediate between them, while Greenall and Bailey (2022) caution that tokenistic inclusion can misrepresent Indigenous knowledge and weaken its educational value. These findings suggest that students are most likely to view IK positively when schools present it systematically, ethically, and in clear relation to curriculum and assessment.

THEORETICAL FRAMEWORK

This study was guided by Constructivist Learning Theory, which views learning as an active process in which learners construct knowledge by linking new information to prior experiences and existing understanding (Chand, 2023). Constructivism emphasizes that meaningful learning occurs when learners actively engage with content rather than passively receive information (Chand, 2023). In ecology education, students may understand scientific concepts more effectively when new ideas are connected to familiar environmental experiences (García Franco et al., 2022; Latip et al., 2024). Indigenous Knowledge provides such experiences through local practices, observations, and environmental interactions that are familiar to learners (Berkes, 2018; Thompson et al., 2020). Integrating IK into ecology teaching can therefore help students relate abstract concepts to real-life situations and strengthen understanding, engagement, and retention (Greenall & Bailey, 2022; Latip et al., 2024). Constructivist Learning Theory was appropriate for this study because it explains how students can use their existing environmental experiences and community knowledge as foundations for constructing ecological understanding (Chand, 2023).

RESEARCH METHODOLOGY

This study employed a qualitative research approach within an interpretive paradigm to explore students' perceptions of learning ecology through Indigenous Knowledge in secondary schools in Dodoma, Tanzania. A qualitative approach was considered appropriate because it enabled an in-depth understanding of students' experiences, views, and interpretations regarding the integration of Indigenous Knowledge in ecology instruction (Yin, 2018).

The study adopted a qualitative multiple-case design involving four selected secondary schools in Dodoma City. By treating each school as a bounded educational setting, the design enabled the researcher to examine students' perceptions in their natural classrooms and compare how IK-related learning appeared across different school contexts. The design therefore produced context-rich explanations of the phenomenon rather than statistical generalizations (Yin, 2018).

This paper reports the student-focused component of the broader dissertation study. The researcher used criterion-based purposive sampling to select 32 Form Six Biology students, eight from each school, who had studied ecology and could provide information-rich accounts of IK-related learning. This qualitative sampling strategy prioritized relevant experience while retaining variation across the four school contexts (Palinkas et al., 2015).

The researcher collected data through focus group discussions (FGDs), classroom observations, and documentary review. The FGDs served as the primary source of students' accounts; classroom observations examined participation and the use of local examples during ecology lessons; and the documentary review examined the Biology syllabus and available lesson plans for evidence of planned IK integration. The researcher used the latter two sources to corroborate and contextualize the students' accounts, consistent with the use of multiple evidence sources in qualitative case-study inquiry (Yin, 2018).

The researcher analyzed the data through reflexive thematic analysis following Kiger and Varpio (2020). She repeatedly read the transcripts and field notes, generated initial codes, grouped related codes into candidate themes, reviewed the themes against the complete dataset, and interpreted them in relation to the study objectives. This process produced themes that captured both the perceived benefits and the limitations of learning ecology through IK.

To strengthen the trustworthiness of the findings, the researcher triangulated evidence from the FGDs, classroom observations, and documentary review during analysis, consistent with the use of multiple evidence sources in qualitative case studies (Yin, 2018). She also explained the purpose of the study, voluntary participation, the right to withdraw, confidentiality, and the academic use of the data before obtaining participants' consent.

FINDINGS AND DISCUSSION

This section presents the themes generated from the student FGDs. Documentary review provides contextual evidence about formal curriculum support, while the direct quotations preserve participants' voices. The discussion first considers perceived benefits conceptual understanding, interest and participation, real-life relevance, and appreciation of community knowledge before examining challenges of inconsistency, limited instructional time, weak conceptual linkage, and insufficient curricular support. The supporting literature shows how the findings relate to previous scholarship.

Learning Ecology through Indigenous Knowledge

Across the four FGDs, students generally described IK as a valuable bridge between formal ecology and familiar community experience. They explained that examples drawn from farming, weather observation, pest control, and conservation made abstract concepts easier to understand, encouraged them to contribute to discussion, and demonstrated the practical relevance of ecology. They also valued the recognition of knowledge held by parents and elders. The analysis therefore treats students' FGD accounts as the primary evidence for these perceptions.

Enhancing understanding of ecological concepts

Participants reported that Indigenous Knowledge enhanced their understanding of ecological concepts by linking scientific content with familiar environmental experiences. Students explained that ecology topics became easier to understand when teachers incorporated examples from farming activities, environmental changes, and other environmental practices observed within their communities. Through such contextualized instruction, learners were able to relate abstract ecological concepts to real-life situations, thereby improving comprehension and meaningful learning.

One participant explained:

“When the teacher explains ecology using examples from farming activities that we see in our communities, it becomes easier to understand how organisms interact with the environment” (FGD Participant 4, School B, February 2026).

This finding supports Constructivist Learning Theory, which emphasizes that meaningful learning occurs when new knowledge is connected to learners’ prior experiences and existing understanding (Chand, 2023). By drawing upon familiar environmental practices, Indigenous Knowledge enables students to construct an understanding of ecological concepts more effectively. Similar findings were reported by García Franco et al. (2022) and Latip et al. (2024), who found that culturally relevant and context-based learning approaches improve students’ conceptual understanding by reducing the abstract nature of scientific content.

A second student described the same process from the perspective of scientific terminology:

“Sometimes ecology topics involve many scientific terms, but when teachers explain them using examples from the village, such as farming or environmental changes, we understand the topic better” (FGD Participant 2, School D, February 2026).

This additional account strengthens the pattern across the focus groups by showing that familiar examples do more than make lessons relatable; they also help students interpret technical ecological language through situations they already understand.

The finding therefore suggests that Indigenous Knowledge can operate as a cognitive bridge between prior experience and formal ecological explanation. This interpretation is consistent with Chand (2023), who emphasizes that new knowledge is constructed more effectively when it is connected to existing understanding, and with Latip et al. (2024), who report that locally grounded science learning can reduce the abstraction of scientific content. At the same time, contextual familiarity should not replace scientific explanation. Aikenhead and Ogawa (2007) stress the importance of helping learners move deliberately between knowledge traditions. In practice, the strongest pedagogical value is likely to occur when a teacher begins with a familiar community example and then explicitly identifies the ecological concept, mechanism, or relationship illustrated by that example.

Increasing students' interest and participation in ecology lessons

The findings further indicated that IK increased students' interest and participation in ecology lessons. Participants explained that lessons became more enjoyable when teachers used examples from local environmental practices and invited learners to share related experiences. One student stated:

"Ecology becomes more interesting when the teacher talks about practices that we see in our communities, such as farming or environmental protection" (FGD Participant 6, School B, February 2026).

This account shows that IK supported engagement by reducing the distance between school science and everyday life. Greenall and Bailey (2022) likewise observed that familiar ecological knowledge can stimulate curiosity, while Ladson-Billings (2021) explains that culturally relevant teaching promotes participation by validating learners' backgrounds. In the present study, the implication is that teachers should not merely mention local examples; they should use them to initiate dialogue, comparison, and explanation so that students participate as contributors to knowledge construction.

The focus groups also linked interest with memory and participation. One student explained:

"It is easier to remember ecology topics when the teacher explains them using things we see in real life. It makes the lesson more enjoyable" (FGD Participant 3, School C, February 2026).

Another participant noted:

"Sometimes the teacher asks us to share what we have seen in our villages about farming or environmental changes. This makes the lesson more interesting because many students want to contribute" (FGD Participant 1, School C, February 2026).

These responses show that students associated relevant examples with both sustained attention and a greater willingness to take part in classroom discussion.

This pattern extends the discussion beyond enjoyment alone. When students are invited to contribute environmental experiences from home and community life, they become active participants in the construction of classroom meaning rather than recipients of examples supplied only by the teacher. This is consistent with the constructivist orientation of the study and with Ladson-Billings (2021), whose culturally relevant pedagogy emphasizes the educational value of recognizing learners' backgrounds. Greenall and Bailey (2022) similarly argue that meaningful inclusion of traditional ecological knowledge can improve engagement when it is integrated into learning activities rather than added superficially. Thus, student interest in the present study appears to arise from a combination of familiarity, recognition, and opportunity to participate.

Strengthening connections between classroom learning and real-life environmental experiences

Another important finding was that Indigenous Knowledge strengthened the connection between classroom learning and real-life environmental experiences. Students explained that ecological concepts became more meaningful when linked to environmental observations and practices within their communities. One participant explained:

“In our village, people observe nature to understand seasons and farming conditions. When teachers explain these things in ecology lessons, it helps us see how science is connected to what people do in real life” (FGD Participant 1, School A, February 2026).

Other students described the same practical connection. One participant noted, “When we learn about ecology using examples from farming or environmental practices in our villages, we realize that what we study in class is also happening in real life” (FGD Participant 5, School B, February 2026). Discussions involving farming practices, seasonal changes, and environmental management enabled learners to recognize the practical application of ecological principles in everyday life. As a result, students perceived ecology not merely as an academic subject but as knowledge directly connected to community experiences and environmental realities.

These findings align with Berkes (2018) and Thompson et al. (2020), who describe IK as environmental understanding developed through sustained observation and practice. For the present study, this means that IK can function as a pedagogical bridge that helps students transfer ecological concepts beyond examinations to the interpretation of local environmental conditions. Nevertheless, teachers need to make the scientific relationship explicit; otherwise, familiar examples may remain anecdotes rather than sources of deeper ecological understanding (Aikenhead & Ogawa, 2007).

A further participant made the transfer between school knowledge and everyday observation explicit:

“Sometimes when we learn about ecosystems or environmental changes in class, we remember things we have seen at home, like changes in rainfall or farming practices” (FGD Participant 2, School C, February 2026).

This response indicates that students were not only recognizing familiar examples during lessons but were also using classroom ecology to reinterpret environmental events they had previously observed. In this sense, Indigenous Knowledge supported movement in both directions: community experience helped students understand ecology, while ecological concepts gave students a scientific language for reflecting on community experience.

The connection is important for the practical purpose of ecology education. Berkes (2018) characterizes Indigenous Knowledge as knowledge developed through long-term interaction with local environments, while Thompson et al. (2020) emphasize observation, experience, and practice as central features of such knowledge systems. When these forms of experience

are brought into classroom discussion, students can see ecological relationships as processes operating in their own surroundings rather than only as textbook descriptions. The focus-group accounts also suggest a possible benefit for retention because familiar situations provide concrete reference points for recalling concepts. However, as Aikenhead and Ogawa (2007) caution, teachers still need to make the conceptual connection explicit so that the familiar experience becomes evidence for ecological reasoning rather than remaining an isolated story.

Appreciation of community environmental knowledge

Students also reported that IK increased their respect for environmental knowledge held by parents, elders, and other community members. They began to recognize that knowledge about seasons, crops, conservation, and environmental change could contribute to understanding ecology at school. One participant explained:

“Our parents and elders know many things about the environment, such as how to observe seasons or protect crops. When we learn ecology, we see that some of this knowledge is related to what we study in school” (FGD Participant 7, School C, February 2026).

This response indicates that IK integration influenced both cognitive learning and students’ judgments about whose knowledge counts in the classroom. Berkes (2018) emphasizes the value of community-based environmental understanding, while Ladson-Billings (2021) links cultural recognition to affirmation and belonging. In this study, culturally responsive ecology teaching can strengthen respect for community knowledge without treating it as a substitute for scientific inquiry; instead, teachers can guide students to compare, test, and connect the two knowledge systems.

A similar view appeared in another focus group, where a student stated:

“Sometimes we learn things in class that we also see happening in our communities. This makes us realize that our elders also know the environment” (FGD Participant 8, School D, February 2026).

The statement is significant because it shows a change not only in what students understand but also in how they evaluate sources of knowledge. Community experience becomes visible as a resource that can enter academic discussion, rather than remaining separate from school science. This interpretation corresponds with Ladson-Billings (2021), who links culturally relevant teaching with recognition of learners’ cultural knowledge, and with Berkes (2018), who documents the ecological value of knowledge accumulated through long-term community-environment relationships. Such recognition should nevertheless be handled critically and respectfully, with teachers presenting Indigenous Knowledge as a complementary resource that can be compared with scientific explanations rather than treating either knowledge system uncritically.

Challenges in Learning Ecology through Indigenous Knowledge

Despite these positive perceptions, the FGDs revealed several barriers to effective IK integration. Students identified inconsistent use across lessons, limited instructional time, and weak explanation of the relationship between Indigenous and scientific knowledge. The documentary review provided contextual evidence that these difficulties were linked to textbook dependence, syllabus pressure, and limited formal guidance rather than simply to individual student preferences.

Inconsistent use of Indigenous Knowledge across ecology lessons

One of the most frequently reported concerns was the inconsistent use of Indigenous Knowledge across ecology lessons. Students explained that some teachers occasionally incorporated examples from local environmental practices, while others relied primarily on textbook-based instruction. Consequently, exposure to Indigenous Knowledge varied considerably across classrooms and lessons. One participant noted:

“Sometimes teachers explain ecology using examples from the community, but it does not happen in every lesson. Many times, the teacher follows the textbook only” (FGD Participant 6, School A, February 2026).

This finding suggests that IK integration often depends on individual teacher initiative rather than being systematically embedded in instructional practice. Mkhwebane (2024) similarly found that teachers’ confidence, experience, and access to support shape how consistently they use Indigenous knowledge in science classrooms. Komba and Shukia (2023) likewise identified systemic barriers to implementing curriculum intentions. Together, these studies indicate that consistent integration requires institutional guidance rather than relying solely on individual enthusiasm.

The inconsistency reported by students also means that the benefits described in the preceding themes are unlikely to be experienced equally across schools, teachers, or individual ecology topics. A learner may encounter a strong contextual explanation in one lesson and then return to exclusively textbook-based instruction in the next. This uneven exposure can make IK appear optional rather than a legitimate pedagogical resource. The finding therefore reinforces Mkhwebane’s (2024) argument that teacher confidence and institutional support influence the consistency of integration. It is also consistent with the implementation gap identified by Komba and Shukia (2023). A more systematic approach would require teachers to identify, during lesson planning, where locally grounded examples can directly support specific ecology learning outcomes instead of depending on spontaneous references during instruction.

Limited instructional time

Students also indicated that limited instructional time restricted the integration of IK in ecology lessons. They explained that teachers often prioritized syllabus coverage and examination preparation, leaving little opportunity for extended discussion of contextual examples and community experience. One student stated:

“Some teachers want to include examples from our communities, but sometimes they say there is not enough time because they must finish the syllabus” (FGD Participant 4, School A, February 2026).

Komba and Shukia (2023) identified weaknesses in curriculum implementation, providing a broader context for the instructional constraints reported here. In the present study, time pressure effectively positioned IK as optional enrichment rather than as a route for achieving core ecology outcomes. Unless curriculum planning and assessment recognize contextual examples as legitimate means of teaching required content, teachers are likely to prioritize textbook coverage. Integrating IK into stated learning activities, rather than adding it after syllabus content, would reduce this tension.

The students' accounts show that time pressure is not simply a scheduling problem; it shapes what teachers regard as essential knowledge. When examination preparation and syllabus completion dominate lesson planning, Indigenous examples may be treated as an additional activity that can be omitted when time is limited. Yet the positive findings in this study suggest that contextual examples can be used to teach required ecological concepts rather than being added after the formal content has been covered. Framing IK in this way may reduce the perceived competition between curriculum coverage and contextualized teaching. The implication is that curriculum guidance should demonstrate how a local farming, conservation, or seasonal example can be used within the teaching of an existing concept, thereby supporting syllabus completion while also increasing relevance and understanding.

Inadequate explanation of the relationship between Indigenous Knowledge and scientific concepts

Furthermore, students reported that teachers did not always explain clearly how IK related to scientific ecological concepts. In some lessons, teachers mentioned traditional practices without clarifying their ecological significance. One student explained:

“We hear about some traditional practices, but sometimes the teacher does not explain deeply how they relate to scientific concepts in ecology” (FGD Participant 2, School B, February 2026).

This concern shows that the quality of integration matters as much as its frequency. De Beer and Van Wyk (2021) argue that educators must mediate carefully between Indigenous and scientific knowledge systems, while Aikenhead and Ogawa (2007) emphasize explicit conceptual bridging. In this study, superficial references risk confusing students or reinforcing the idea that IK and science are unrelated. Teachers therefore need to identify the ecological principle illustrated by each local practice, discuss evidence and limitations, and explain where the two knowledge systems converge or differ.

The concern also clarifies why the presence of a local example by itself cannot be treated as evidence of successful integration. Students need to understand the ecological principle represented by the practice, the evidence on which the explanation is based, and any points at which Indigenous and scientific interpretations differ. De Beer and Van Wyk (2021)

emphasize that the relationship between Indigenous Knowledge Systems and Western science requires careful mediation, while Aikenhead and Ogawa (2007) describe the need to help learners move between knowledge traditions without collapsing one into the other. For ecology teaching, this could involve asking students first to describe a familiar practice, then identifying the ecological concept it illustrates, and finally discussing where scientific evidence supports, qualifies, or challenges the local explanation. Such explicit bridging would address the depth-of-explanation concern raised by participants.

Documentary review evidence

The documentary review examined the Biology syllabus and available lesson plans to determine whether IK was formally planned in ecology teaching. The review did not identify a clearly stated IK component, explicit locally grounded learning activities, or assessment guidance for systematic integration. Because the research report did not preserve detailed excerpts from each reviewed document, this evidence is treated as contextual corroboration rather than as a separate independent theme.

Accordingly, the thematic claims in this article rely primarily on the students' FGD quotations. The documentary evidence helps explain why students described integration as intermittent: the reviewed materials offered limited formal direction, leaving teachers to introduce local examples largely at their own discretion. The research report also records the use of classroom observations, but it does not present sufficiently detailed observation extracts to support an independent observation theme in this paper.

The broader dissertation confirms that classroom observation formed part of the data-collection design and that observation notes were considered during analysis. However, the written report does not preserve sufficiently detailed observation episodes that can be attributed to particular lessons and reproduced responsibly in this article. For that reason, no new observation quotations or stand-alone observation findings are introduced here. This preserves the distinction between evidence that is directly documented in the dissertation and evidence that would otherwise have to be reconstructed. The observation component therefore remains corroborative, while the student focus-group data and documentary review provide the reportable evidence for the themes presented in this paper.

These findings are consistent with Mkhwebane (2024), who identified inadequate teacher training and limited support for IK integration in South African Life Sciences classrooms. The curriculum contexts differed: IK was formally mandated in that study, whereas the documents reviewed here offered limited explicit guidance. The studies therefore agree on the need for implementation support, but do not establish identical curriculum conditions. Komba and Shukia (2023) similarly found a gap between intended and enacted curricula in Tanzania. Their focus was 21st-century skills, not ecology or IK, so this comparison supports the broader interpretation of an implementation gap rather than directly confirming the absence of IK guidance. Together, these comparisons suggest that clear curriculum provision and practical teacher support are both relevant to systematic integration.

Overall, students strongly valued IK as a learning resource, but the combined evidence showed that its educational potential was constrained by inconsistent implementation, limited time, weak conceptual linkage, and insufficient curriculum support.

Taken together, the positive perceptions and the reported barriers point to a consistent interpretation: students value Indigenous Knowledge most when it is deliberately connected to formal ecological concepts, but the existing classroom conditions do not always support that level of integration. The benefits greater understanding, participation, real-life relevance, and appreciation of community knowledge are therefore closely related to the quality and consistency of implementation. The challenges are also interconnected. Limited curriculum guidance can increase dependence on individual teacher initiative; this inconsistency can be intensified by time pressure; and when teachers introduce local examples quickly, the conceptual relationship with scientific ecology may remain underexplained. The findings consequently support a move from incidental use of Indigenous examples toward planned pedagogical integration in which local experience is selected because it advances a specific ecology learning objective. Such an approach would remain consistent with constructivist learning while also addressing the implementation concerns expressed by students.

CONCLUSION

This study examined students' perceptions of learning ecology through Indigenous Knowledge in secondary schools in Dodoma, Tanzania. Students perceived IK as a valuable instructional resource because it clarified ecological concepts through familiar environmental experience, increased interest and participation, connected classroom learning to real-life practice, and strengthened appreciation of community knowledge. The documentary review provided contextual evidence that integration remained weakly embedded in curriculum materials. Students identified limited instructional time and insufficient explanation of the relationship between Indigenous and scientific knowledge as additional barriers. The study concludes that IK contributes to more meaningful and culturally relevant ecology learning when teachers integrate it systematically and explicitly connect local examples to scientific concepts.

RECOMMENDATIONS

Teachers should consistently connect local environmental practices with ecological concepts, supported by professional development on IK integration. Curriculum developers and education authorities should provide explicit guidance for incorporating IK into Biology teaching, while schools should support environmental observation projects and interaction with local knowledge holders to connect classroom learning with community experience.

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