International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 10 Issue 10, October - 2026, Pages: 189-195

Indigenous Knowledge In Secondary School Environmental Education

Olaniyi, Oladiran Paul

[1]Department of Geography and Environmental Education, Emmanuel Alayande University of Education, Oyo, Nigeria

Author email: olaniyiop@eauedoyo.edu.ng

ABSTRACT: *This study examined the forms of Indigenous Knowledge relevant to environmental education and assessed the extent of its integration in secondary schools. A convergent parallel mixed-methods design was employed, involving 10 teachers, 100 students, and 3 community elders from selected secondary schools in Oyo, Oyo State, Nigeria. Data were collected through questionnaires, semi-structured interviews, and classroom observations. Quantitative data were analyzed using descriptive statistics, while qualitative data were analyzed thematically. The findings revealed that Indigenous environmental knowledge remains present within communities, particularly in traditional weather forecasting, sacred grove conservation, and indigenous soil management. However, integration into formal environmental education was minimal, with 50% of teachers never incorporating Indigenous Knowledge. When integration occurred, it was limited to brief oral examples rather than experiential approaches. Major barriers included exclusion from curricula and examinations, lack of teacher training, and inadequate teaching materials. Students expressed strong interest in learning Indigenous Knowledge, and elders demonstrated willingness to participate in school-based education. The study concludes that despite recognition of its value, Indigenous Knowledge remains structurally marginalized in formal environmental education. Recommendations include curriculum revision, examination reform, teacher training, and strengthened school-community partnerships.*

Keywords: Environmental education, Indigenous Knowledge, secondary school, teacher attitudes, traditional ecological knowledge

INTRODUCTION

Environmental degradation, including deforestation, soil erosion, water pollution, and biodiversity loss, is accelerating globally, with sub-Saharan Africa experiencing some of the highest rates of ecosystem decline (United Nations Environment Programme [UNEP], 2022). In response, environmental education has been recognized as a major strategy for promoting the awareness, knowledge, attitudes, and practical skills required for sustainable living (UNESCO, 2020). Since the Tbilisi Declaration of 1977, environmental education has increasingly been incorporated into school curricula across many countries, including Nigeria. However, despite decades of policy commitment, the effectiveness of school-based environmental education remains contested, particularly in rural and indigenous communities where formal schooling is often disconnected from local ecological realities (Mawere, 2015; Zidny et al., 2020).

A growing body of scholarship argues that this disconnect arises from the predominantly Western and Eurocentric orientation of most environmental education curricula (Barnhardt & Kawagley, 2005; Berkes, 2018). Conventional environmental education frequently emphasizes universal scientific principles, laboratory-based learning, and textbook explanations, while giving limited attention to place-based, experiential, and culturally embedded knowledge systems. Yet, for many indigenous and rural communities, Indigenous Knowledge provides a practical, adaptive, and locally grounded framework for environmental management and sustainability (Mazzocchi, 2020).

Indigenous Knowledge refers to the cumulative body of knowledge, beliefs, practices, and values developed by indigenous and local communities through long-term interaction with their environment (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES], 2019). Unlike the reductionist orientation of Western science, Indigenous Knowledge is holistic in nature and integrates ecological, social, cultural, spiritual, and ethical dimensions of human existence. Examples include the use of phenological indicators for weather prediction, traditional agroforestry systems that mimic natural ecosystems, taboo systems protecting spawning grounds, and sacred groves that function as biodiversity conservation sites (Berkes, 2018; Colding & Folke, 2001).

The relevance of Indigenous Knowledge to contemporary environmental challenges is increasingly acknowledged internationally. The Intergovernmental Panel on Climate Change (IPCC, 2022) recognizes the importance of Indigenous Knowledge in climate adaptation and disaster risk reduction. UNESCO (2019) has promoted initiatives aimed at integrating indigenous knowledge systems into formal education, arguing that such integration improves cultural relevance, learner engagement, and locally appropriate environmental action. Similarly, Article 8(j) of the Convention on Biological Diversity (CBD, 2010) calls upon member states to respect, preserve, and maintain the knowledge and practices of indigenous and local communities.

Despite these international endorsements, studies across Africa indicate that Indigenous Knowledge remains marginalized within formal secondary school environmental education (Abah et al., 2015; Ochieng' & Ndirangu, 2018; Semali & Kincheloe, 2019). Many

teachers lack adequate training, instructional materials, and curriculum support necessary for integrating Indigenous Knowledge into classroom teaching. Furthermore, national examination systems rarely assess Indigenous Knowledge, thereby discouraging teachers from devoting instructional time to it. Colonial educational legacies also continue to shape perceptions of knowledge, often presenting Indigenous Knowledge as unscientific, outdated, or inferior to Western science (Shizha, 2013). Consequently, many environmentally valuable indigenous practices remain excluded from formal educational processes.

Nigeria presents an important context for examining this issue. A significant proportion of the Nigerian population resides in rural areas where traditional ecological practices continue to influence farming, water management, forest conservation, and climate adaptation. Nigeria is also culturally diverse, with over 250 ethnic groups possessing distinct environmental knowledge systems and ecological traditions. Although the Nigerian National Policy on Education advocates culturally relevant and locally responsive education, secondary school environmental science curricula remain largely textbook-oriented, with limited incorporation of Indigenous Knowledge. This apparent gap between educational policy and classroom practice requires systematic investigation.

The major problem addressed in this study is the persistent exclusion of Indigenous Knowledge from formal secondary school environmental education in Nigeria despite its recognized relevance to sustainable environmental management and culturally responsive learning. Preliminary discussions conducted with secondary school teachers revealed that many educators value Indigenous Knowledge and recognize its usefulness in environmental education. However, they rarely integrate such knowledge into classroom teaching because of curriculum limitations and examination pressures. One teacher explained that although local elders possess reliable traditional methods of predicting drought and rainfall patterns, such knowledge is absent from examination syllabi, compelling teachers to focus mainly on textbook content.

The consequences of this exclusion are considerable. First, it creates epistemic injustice by delegitimizing valid indigenous systems of knowledge and reinforcing colonial hierarchies of knowledge production (de Sousa Santos, 2014). Second, it reduces pedagogical effectiveness because students are denied opportunities to connect classroom learning with their lived environmental experiences. Third, the disconnect between schools and local communities may weaken the intergenerational transmission of valuable environmental practices and sustainable land-use skills. Finally, the exclusion of Indigenous Knowledge limits opportunities for incorporating locally appropriate environmental conservation practices into school-based projects and sustainability initiatives.

Although these concerns are increasingly recognized globally, the precise nature and extent of the problem within secondary schools in Oyo Region have not been adequately documented. There is limited empirical evidence regarding the forms of Indigenous Knowledge available within local communities, the extent to which teachers integrate Indigenous Knowledge into environmental education, the barriers preventing such integration, and the attitudes of students and community elders toward Indigenous Knowledge-based environmental learning. This study therefore seeks to fill this gap by systematically investigating the role of Indigenous Knowledge in environmental education among selected secondary schools in Oyo Region.

The conceptual foundation of this study is the Two-Eyed Seeing framework developed by Mi'kmaw Elders Albert and Murdena Marshall and advanced in academic literature by Hatcher et al. (2009) and Bartlett et al. (2012). The framework advocates the integration of Indigenous and Western knowledge systems in a complementary rather than hierarchical manner. Two-Eyed Seeing proposes that one eye represents Indigenous Knowledge systems, the other eye represents Western scientific knowledge, and together both eyes provide a more complete understanding of reality. This epistemological stance is particularly relevant to environmental education because environmental problems are inherently complex, involving ecological, cultural, economic, and spiritual dimensions.

This study aims to examine the role of Indigenous Knowledge in environmental education among selected secondary schools in Oyo Region. Specifically, the study identifies and documents forms of Indigenous environmental knowledge relevant to environmental education, assesses the extent and methods of Indigenous Knowledge integration by secondary school teachers, examines barriers affecting integration, and investigates students' attitudes toward Indigenous environmental knowledge and elders' willingness to contribute to school-based environmental education. The findings are expected to provide evidence-based recommendations for educational policymakers, curriculum planners, and teachers regarding strategies for integrating Indigenous Knowledge into environmental education curricula and teaching practices.

METHOD

This study adopted a convergent parallel mixed-methods research design. The mixed-methods approach combines quantitative and qualitative research techniques to obtain a comprehensive understanding of the role of Indigenous Knowledge in environmental education. The quantitative component involved structured questionnaires administered to teachers and students, generating numerical data relating to the frequency of Indigenous Knowledge integration, students' attitudes, and barriers affecting implementation. The qualitative component involved semi-structured interviews with teachers and community elders, as well as classroom observations, enabling the researcher to obtain in-depth explanations and contextual insights.

The study was conducted in Oyo, located in south-western Nigeria. Oyo is historically significant for its rich Yoruba cultural heritage and indigenous environmental practices. The area is characterized by both urban and rural settlements, with agriculture serving as

one of the major economic activities. The region experiences a tropical climate with distinct wet and dry seasons. Common environmental challenges in the area include deforestation, soil erosion, declining biodiversity, waste disposal problems, and seasonal water shortages. Indigenous communities within the region possess traditional ecological knowledge relating to farming systems, sacred grove conservation, weather prediction, water management, and biodiversity protection.

The target population for this study comprised three categories of participants: secondary school teachers teaching environmental-related subjects, senior secondary school students, and community elders recognized for their knowledge of indigenous environmental practices. The inclusion of these groups was necessary because they represent the major stakeholders involved in the transmission, teaching, and preservation of Indigenous Knowledge within the community and educational system.

A combination of purposive, systematic random, and snowball sampling techniques was employed. Three public secondary schools were purposively selected based on availability of environmental-related subjects, proximity to indigenous communities, and willingness of school authorities to participate. All teachers responsible for teaching environmental-related subjects in the selected schools were included through census sampling. Students were selected using systematic random sampling, with every fifth student selected from class registers. Community elders were selected through snowball sampling, with initial contacts made through traditional leaders who then identified other elders recognized for their environmental knowledge.

The study sample consisted of 10 teachers, 100 students, and 3 community elders. In addition, six classroom lessons were observed across the selected schools. Four major instruments were used for data collection: teacher questionnaire, student questionnaire, semi-structured interview guide for teachers and community elders, and classroom observation checklist. The teacher questionnaire consisted of structured and semi-structured questions divided into sections on demographic information, awareness of Indigenous Knowledge, extent of Indigenous Knowledge integration, and barriers to integration. The student questionnaire focused on awareness of Indigenous Knowledge, attitudes toward indigenous environmental practices, and interest in learning Indigenous Knowledge within school settings.

To ensure face and content validity, the research instruments were reviewed by experts in Environmental Education and Research Methods. Suggestions relating to clarity, relevance, and cultural appropriateness were incorporated into the final versions. A pilot study was conducted using teachers and students from a secondary school outside the study area but possessing similar characteristics. Cronbach's Alpha was used to test reliability of Likert-scale items, with results indicating acceptable levels of internal consistency: teacher awareness scale ($\alpha = 0.82$), teacher attitude scale ($\alpha = 0.79$), and student attitude scale ($\alpha = 0.71$).

Data collection was carried out over a six-week period. The researcher obtained an introductory letter from the university and secured approval from relevant educational authorities and school principals. Consent was also obtained from participants before data collection commenced. Teacher questionnaires were administered personally during free periods, while student questionnaires were administered in classrooms under supervision. Semi-structured interviews were conducted with selected teachers and community elders, with interviews conducted in Yoruba language where necessary and later translated into English. Classroom observations were conducted during environmental-related lessons to observe teaching methods and the use of Indigenous Knowledge during instruction.

Quantitative data obtained from questionnaires were coded and analyzed using the Statistical Package for Social Sciences (SPSS) Version 26, employing frequencies, percentages, means, standard deviations, and ranking analysis. Qualitative data from interviews and classroom observations were analyzed using thematic analysis, involving transcription, repeated reading, coding, identification of themes, and interpretation of findings. Relevant quotations from participants were used to support major themes identified during analysis.

RESULTS AND DISCUSSION

3.1. Results

3.1.1. Demographic Characteristics

The response rate was 100% across all participant categories. Among teachers (N=10), 70% were male and 30% female. Most teachers had between 5 and 10 years of teaching experience (40%). Teachers taught Biology (6), Geography (5), Agricultural Science (4), and Environmental Science (3). Only one teacher (10%) had previously received any form of training related to Indigenous Knowledge. Among students (N=100), 56% were male and 44% female. Most students were in Senior Secondary II (54%) and Senior Secondary III (46%). Only 31% were members of environmental clubs, while 85% had resided in the study community since birth.

3.1.2. Research Question One: Forms of Indigenous Environmental Knowledge

Teachers identified various Indigenous Knowledge practices existing within their communities. Traditional weather forecasting was recognized by all teachers (100%). Sacred forests and groves were identified by 90%, indigenous soil conservation methods by 80%, traditional fishing restrictions by 70%, indigenous pest control practices by 60%, traditional crop rotation systems by 50%, and indigenous tree planting traditions by 20%.

Table 1. Indigenous Knowledge Practices Identified by Teachers (N = 10)

Indigenous Knowledge Practice	Frequency	Percentage
Traditional weather forecasting	10	100%
Sacred forests and groves	9	90%
Indigenous soil conservation methods	8	80%
Traditional fishing restrictions	7	70%
Indigenous pest control practices	6	60%
Traditional crop rotation systems	5	50%
Indigenous tree planting traditions	2	20%

3.1.3. Research Question Two: Extent of Indigenous Knowledge Integration

The frequency of Indigenous Knowledge integration revealed that 50% of teachers had never integrated Indigenous Knowledge into their lessons during the previous year. Among those who used Indigenous Knowledge, 30% had done so once or twice, 10% three to five times, and 10% more than five times. The methods used for integration were primarily brief oral examples during lessons (100%). No teachers had organized field trips to indigenous environmental sites or invited elders as guest speakers.

3.1.4. Research Question Three: Barriers to Indigenous Knowledge Integration

Teachers ranked six possible barriers affecting Indigenous Knowledge integration. The results revealed that the absence of Indigenous Knowledge in the national curriculum and examinations was the most critical barrier (Mean Rank = 1.4), followed by lack of teacher training (Mean Rank = 2.1), inadequate teaching materials (Mean Rank = 2.4), language barriers (Mean Rank = 4.0), and limited classroom time (Mean Rank = 4.3). The belief that Indigenous Knowledge is unscientific ranked lowest (Mean Rank = 5.2), suggesting that structural and institutional challenges, rather than teachers' attitudes, constitute the major constraints.

Table 2. Ranking of Barriers to Indigenous Knowledge Integration

Barrier	Mean Rank	Rank Position
Absence in syllabus and examinations	1.4	1st
Lack of teacher training	2.1	2nd
Lack of teaching materials	2.4	3rd
Language barriers	4.0	4th
Limited classroom time	4.3	5th
Perception as unscientific	5.2	6th

3.1.5. Research Question Four: Student Attitudes and Elder Perspectives

Students generally expressed positive attitudes toward Indigenous Knowledge. The majority (81%) indicated they would like to learn Indigenous environmental knowledge in school, while 73% agreed that Indigenous Knowledge can contribute to environmental protection. However, 62% believed that teachers relied more on textbook science than on local knowledge, and only 6% reported that community elders had ever participated in environmental lessons at their schools.

Table 3. Students' Attitudes Toward Indigenous Knowledge (N = 100)

Statement	Yes n (%)	Somewhat n (%)	No n (%)
Would like to learn IK in school	81 (81.0)	13 (13.0)	6 (6.0)
IK can help protect environment	73 (73.0)	19 (19.0)	8 (8.0)
Teachers prefer textbook science	62 (62.0)	24 (24.0)	14 (14.0)
Elders have spoken in school	6 (6.0)	10 (10.0)	84 (84.0)

All three community elders interviewed expressed willingness to participate in school environmental education if invited. One elder stated: "I may not farm much again because of age, but I can still teach the children what our ancestors taught us about forests and rain" (E1). Elders also expressed concern that younger generations were gradually abandoning indigenous environmental practices due to modernization and technology. Another elder observed: "Children now depend on phones and modern life. They no longer respect traditional ways of protecting nature" (E3).

Classroom observations confirmed that integration was minimal. Five out of six observed lessons contained no reference to Indigenous Knowledge. Teaching was heavily textbook-oriented, local examples were rarely used, and no elders participated in lessons. In one lesson, a student mentioned: "My grandmother says planting should not begin until a certain tree flowers," but the teacher acknowledged the statement briefly and immediately returned to the textbook discussion.

3.2. Discussion

The finding that rich Indigenous Knowledge exists within the study community, including weather forecasting practices, sacred groves, and traditional soil conservation methods, is consistent with existing ethnoecological literature (Berkes, 2018; Ford & Martinez, 2020). The study extends previous scholarship by documenting specific forms of Indigenous Knowledge recognized by teachers within the study area, providing an empirical baseline for future interventions and curriculum development. However, teachers' understanding of Indigenous Knowledge appeared largely superficial, with many participants acknowledging the existence of indigenous environmental practices without demonstrating in-depth knowledge of their mechanisms or applications. This finding supports the results of Mkhwanazi (2019), who argued that limited depth of knowledge, rather than unwillingness, constitutes a major obstacle to effective integration.

The finding that integration of Indigenous Knowledge into environmental education remains minimal is more severe than that reported by Ochieng' and Ndirangu (2018) in Kenya but comparable to findings by Ugwu and Eze (2020) in Nigeria. When Indigenous Knowledge was incorporated, it was generally presented in tokenistic forms, such as brief anecdotes or isolated references, rather than through experiential learning approaches, community engagement, or field-based activities. This aligns with the argument of Semali and Kincheloe (2019) that educational content not reflected in assessment systems is unlikely to receive sustained classroom attention. The results suggest that Indigenous Knowledge integration remains symbolic rather than substantive, despite increasing global discourse on inclusive and culturally responsive education.

One of the most significant findings relates to the nature of barriers affecting Indigenous Knowledge integration. Teachers consistently identified the exclusion of Indigenous Knowledge from national syllabi and examination systems as the most severe challenge. This finding helps explain why previous initiatives focused solely on teacher sensitization or professional development have produced limited results. As noted by Msila (2020), curriculum and assessment structures strongly shape classroom practices. Teachers in this study demonstrated willingness to integrate Indigenous Knowledge but felt constrained by institutional expectations and examination-oriented teaching cultures. The finding that the perception of Indigenous Knowledge as "unscientific" ranked lowest contradicts assumptions in earlier literature suggesting that teachers inherently devalue indigenous knowledge systems (Shizha, 2013), instead suggesting that teachers generally recognize the value of Indigenous Knowledge but lack the institutional support required for implementation.

The high level of student interest in Indigenous Knowledge observed in this study is consistent with the findings of Ugwu and Eze (2020) and suggests that students are not barriers to integration but potential facilitators of culturally responsive environmental education. Although a small number of students associated indigenous practices with outdated traditions, the majority expressed curiosity and willingness to learn from community-based knowledge systems. Similarly, community elders demonstrated strong willingness to contribute to school-based environmental education. However, despite this willingness, very few had ever been invited to participate in formal teaching activities. This finding highlights a significant untapped educational resource, as schools are situated within communities possessing extensive environmental expertise, yet institutional structures rarely create opportunities for meaningful collaboration between schools and local knowledge holders.

The study supports the central premise of the Two-Eyed Seeing framework, which advocates complementarity between Indigenous Knowledge and Western scientific knowledge. However, the findings extend the framework by demonstrating that meaningful complementarity cannot occur within educational systems that privilege only Western scientific epistemologies in curriculum and assessment structures. The results suggest that successful implementation of Two-Eyed Seeing depends not only on pedagogical acceptance but also on structural reforms in curriculum development, teacher education, and national assessment systems.

CONCLUSION

This study examined the forms of Indigenous Knowledge relevant to environmental education, the extent of its integration in secondary schools, barriers affecting integration, and stakeholder attitudes in Oyo Region, Nigeria. The findings reveal that Indigenous environmental knowledge remains present and recognizable within the study community, particularly in areas such as weather forecasting, sacred grove conservation, soil management, and agroecological practices. However, teachers' understanding of this knowledge is often superficial and insufficient for confident instructional delivery. Integration into formal environmental education is minimal, with half of teachers never incorporating Indigenous Knowledge. Where integration occurs, it is generally limited to superficial references rather than sustained or experiential pedagogical practices.

The major barriers to Indigenous Knowledge integration are structural rather than attitudinal. Teachers generally value Indigenous Knowledge and demonstrate willingness to integrate it but are constrained by curriculum limitations, examination systems, inadequate training, and lack of teaching resources. Students demonstrate strong interest in Indigenous Knowledge, while community elders show willingness to contribute to school-based learning. These groups therefore represent important but underutilized

educational resources. The Two-Eyed Seeing framework provides a relevant conceptual basis for integrating Indigenous Knowledge and Western scientific knowledge within environmental education; however, effective implementation requires structural reforms within curriculum development, teacher education, and national assessment systems.

Recommendations include revising national environmental education curricula to include clearly defined Indigenous Knowledge competencies, incorporating Indigenous Knowledge components into national examination systems, documenting local environmental knowledge and developing supplementary teaching materials, introducing compulsory modules on Indigenous Knowledge in teacher education programmes, establishing structured community engagement programmes with elders and local experts, and developing demonstration gardens or environmental learning sites where indigenous and scientific conservation practices can be taught comparatively. Future research should examine changes in Indigenous Knowledge integration over time, measure students' actual learning outcomes resulting from Indigenous Knowledge integration, and compare different models of Indigenous Knowledge integration across various Nigerian contexts.

ACKNOWLEDGEMENTS
The authors express gratitude to the school principals, teachers, students, and community elders who participated in this research. Appreciation is extended to colleagues who provided valuable feedback during the research process.

DECLARATION OF INTEREST

The authors declare no conflicts of interest.

RESEARCH FUNDING

This research did not receive any financial support.

ETHICAL STATEMENT
This research was conducted following ethical guidelines for educational research. Informed consent was obtained from all participantsConfidentiality and anonymity were maintained throughout the study.

REFERENCES

Abah, J., Mashebe, P., & Denuga, D. D. (2015). Prospect of integrating African indigenous knowledge systems into the teaching of sciences in Africa. *American Journal of Educational Research, 3*(6), 668–673. https://doi.org/10.12691/education-3-6-1

Barnhardt, R., & Kawagley, A. O. (2005). Indigenous knowledge systems and Alaska Native ways of knowing. *Anthropology & Education Quarterly, 36*(1), 8–23. https://doi.org/10.1525/aeq.2005.36.1.008

Bartlett, C., Marshall, M., & Marshall, A. (2012). Two-Eyed Seeing and other lessons learned within a co-learning journey of bringing together Indigenous and mainstream knowledges and ways of knowing. *Journal of Environmental Studies and Sciences, 2*(4), 331–340. https://doi.org/10.1007/s13412-012-0086-8

Berkes, F. (2018). *Sacred ecology* (4th ed.). Routledge.

Colding, J., & Folke, C. (2001). Social taboos: "Invisible" systems of local resource management and biological conservation. *Ecological Applications, 11*(2), 584–600. https://doi.org/10.1890/1051-0761(2001)011[0584:STISOL]2.0.CO;2

de Sousa Santos, B. (2014). *Epistemologies of the South: Justice against epistemicide*. Paradigm Publishers.

Ford, J. D., & Martinez, D. (2020). Traditional ecological knowledge and climate change adaptation. In D. C. Natcher & T. M. Koontz (Eds.), *Indigenous environmental knowledge* (pp. 45–67). Springer.

Hatcher, A., Bartlett, C., Marshall, A., & Marshall, M. (2009). Two-Eyed Seeing in the classroom environment: Concepts, approaches, and challenges. *Canadian Journal of Science, Mathematics and Technology Education, 9*(3), 141–153. https://doi.org/10.1080/14926150903124442

IPBES. (2019). *Global assessment report on biodiversity and ecosystem services*. IPBES Secretariat.

IPCC. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. Cambridge University Press.

Mawere, M. (2015). Indigenous knowledge and public education in sub-Saharan Africa. In M. N. Nhemachena & P. M. Hleza (Eds.), *Re-thinking the social sciences in the 21st century* (pp. 89–104). Langaa RPCIG.

Mazzocchi, F. (2020). A deeper meaning of sustainability: Insights from Indigenous knowledge. *Anthropocene Review, 7*(1), 77–93. https://doi.org/10.1177/2053019619898888

Mkhwanazi, S. (2019). *Teachers' perceptions of integrating Indigenous knowledge into agricultural science lessons in KwaZulu-Natal* (Unpublished master's dissertation). University of KwaZulu-Natal.

Msila, V. (2020). Indigenous knowledge systems in South African education: Policy, implementation and challenges. *South African Journal of Education, 40*(2), Article 1789. https://doi.org/10.15700/saje.v40n2a1789

Ochieng', F., & Ndirangu, M. (2018). Integration of Indigenous Knowledge in environmental education in Kenya: Teachers' perspectives. *Journal of Education and Practice, 9*(15), 12–21.

Semali, L. M., & Kincheloe, J. L. (2019). *What is Indigenous knowledge? Voices from the academy*. Routledge.

Shizha, E. (2013). Reclaiming Indigenous knowledge in Africa's education curricula. In G. J. S. Dei (Ed.), *Indigenous philosophies and critical education* (pp. 223–240). Peter Lang.

Ugwu, C. I., & Eze, P. I. (2020). Effect of Indigenous knowledge-based environmental education on students' conservation attitudes in Enugu State, Nigeria. *Nigerian Journal of Environmental Education, 12*(1), 34–47.

UNEP. (2022). *Africa environment outlook: Summary for policy makers*. UNEP.

UNESCO. (2019). *Indigenous knowledge for climate change assessment and adaptation*. UNESCO Publishing.

UNESCO. (2020). *Education for sustainable development: A roadmap*. UNESCO.

Zidny, R., Sjöström, J., & Eilks, I. (2020). A multi-perspective reflection on how Indigenous knowledge can help the realization of inclusive and sustainable science education. *Science Education International, 31*(3), 221–231. https://doi.org/10.33828/sei.v31.i3.1