

Research Article

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Africanising Environmental Education through Indigenous Knowledge Systems: A Technology Education Teachers' Case

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Abstract

Background/purpose. Each country uses the curriculum as a vehicle to support and guide both teaching and learning within its education system, as is the case in South Africa. Post-1994 in South Africa (SA), several efforts were undertaken to address past educational inequalities, leading to rapid curriculum reform, overhaul, review, and/or transformation. The study examined Technology Education (TE) teachers' efforts to Africanise Environmental Education (EE) through Indigenous Knowledge Systems (IKS) underpinned by cultural absolutism theory. The literature revealed that less inquiry has been undertaken with TE teachers' Africanising EE through IKS.

Materials/Methods. In this community engagement project, action research was used as a research design to emancipate TE teachers. The study involved interviewing eight purposively sampled TE teachers from six schools teaching in the Senior Phase (Grades 7, 8, and 9) who served as participants, co-researchers, or respondents in this study. Data was collected from eight TE Senior Phase teachers in three villages and coded using thematic analysis.

Results. The study found that the TE curriculum embraces IKS and EE; however, TE teachers struggle to facilitate their EE interaction and IKS integration when delivering lessons to their learners. Therefore, curriculum designers should develop active programs to assist TE teachers in improving their teaching strategies to meet the curriculum's Africanisation needs.

Conclusion. The study focuses on Africanising the subject content of EE through IKS, using TE teachers as a case study. It is a common belief that every country should take pride in the investments it makes in its education system, which serves as an enabling environment for advancing the country. A nation that fosters an environment conducive to the efficient operation of its human capital will be able to grow its economy rapidly. It would not befit to unpack the concepts of Africanising the curriculum without mentioning the decolonisation of the education system.

1. Introduction

Africanising the education system refers to the process of adapting subject content to reflect ideas and practices informed by African traditions, culture, techniques, and/or knowledge (Gumbo, 2020). Higgs (2016, pp. 87-88) further this claim by asserting that Africanisation is a process that accords equal status and validity to knowledge systems as ways of knowing, just as other knowledge systems. The study focuses on Africanising the subject content of Environmental Education (EE) through Indigenous Knowledge Systems (IKS), using Technology Education (TE) teachers as a case study. It is a common belief that every country should take pride in the investments it makes in its education system, which serves as an enabling environment for advancing the country. A nation that fosters an environment conducive to the efficient operation of its human capital typically reaps benefits in the form of highly innovative products and services (Ezeanya-Esiobu, 2019). The enabling milieu is evident in both EE and TE, as these subjects complement each other, even though they are rooted in IKS and are both practical. In addition, the TE subject is environmentally oriented, in line with the Department of Basic Education (DBE) policy in South Africa. In the educational context, DBE (2011, p. 8) defines TE as the use of knowledge, skills, values, and resources to meet people's needs and wants by developing practical solutions to problems, considering social and environmental factors. Globally, efforts are underway to ensure that IKS is used by a variety of academic, private, and non-governmental organisations (Maila & Loubser, 2003). Various IKS have established systems and practices for water collection, preservation, storage, and sanitation that are sustained within the community setting (Tharakan, 2017). The island country Madagascar lies off the southeastern coast of Africa and has developed sustainable IKS treatment techniques and practices. Madagascar's claims concerning Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) or Coronavirus Disease 2019 (COVID-19) were dismissed by Western and scientific communities, who undermine the power of IKS. Mapotse (2025, p. 261) refers to IKS as the bits of knowledge from indigenous communities the world over, which were acquired over a lengthy period and transferred from one generation to another, in a variety of ways, to preserve cultural practices whilst observing the community's evolution into technological practices, due to the industrial revolutions. The country of Madagascar claimed to have developed a COVID-19 vaccine using indigenous herbs (Ufearoh, 2020). However, their claim was met with mixed reactions, simply because the vaccine cannot be scientifically proven. This is because Indigenous worldviews observe knowledge differently from Western worldviews (Kapyrka & Dockstator, 2012). The effectiveness of school curricula, especially TE and EE, could help bridge Indigenous and Western worldviews, as learners and teachers spend most of their time at school engaged in teaching and learning. Stapp (1969, p. 34) defines EE as "a process that is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of and how to help solve its problems, and motivated to work towards their solution". This definition captures the essence of indigenous people's practice in the environment.

With most of Africa gaining independence, democracies emerging, and governments composed primarily of native Africans, there seems to be a push to "resuscitate" the dignity and legacy of Africa's Indigenous peoples (Meyiwa & Maseti, 2015). Given the underutilisation of indigenous technologies among indigenous peoples, perhaps schools should bear some of the blame for not teaching societies about IKS. It is against this background that TE teachers at schools are at liberty to teach learners about IKS and stimulate learners' interest in the subject. Some critics argue that the school curriculum is still too Westernised and too abstract for African learners (Gumbo, 2017a), and EE programs in schools are generally taught from a Western perspective and do not engage Indigenous content (Kapyrka & Dockstator, 2012). Considering the above, this study aims to explore TE teachers' approaches to Africanising EE through IKS. It is time for EE, indigenous technology in TE, and IKS to claim their rightful place in society to mitigate socio-economic issues, among other issues.

The interaction could help address the imbalance of downplaying IKS in the school curriculum. The ensuing section provides background for this study and offers a glimpse of the research problem.

1.1. Background

Each country uses the curriculum as a vehicle to support and guide both teaching and learning within its education system, as is the case in South Africa. Post-1994 in South Africa (SA), several efforts were undertaken to address past educational inequalities, leading to rapid curriculum reform, overhaul, review, and/or transformation. According to Mapotse (2012), most South African instructors have struggled with the education system amid a rapid transformation initiated by the 1976 learner cohort (the Soweto learners' rebellion). However, curricular reform in SA has proved problematic for teachers (Mlambo, 2015, p. 1), while curriculum transformation has a profound influence on the other challenges experienced by Technology teachers (Mapotse, 2012). One such example of teachers' challenges is when they try to integrate EE and IKS into TE. Jita and Mokhele (2013, p. 33) highlight the problem faced by teachers (including TE teachers) by noting that there are no substantive plans or guidelines to guide teachers in integrating environmental learning into their school subjects. This may deny learners the opportunity to learn about environmental problems that can be mitigated through IKS. The practical nature of IKS aligns well with the technology realm, enabling learners to design indigenous, informed solutions to technological problems (Gumbo, 2019). The Department of Basic Education (2011) in South Africa has integrated IKS into its school curriculum. Through EE and TE, South Africa aims to educate learners about the richness of the country's history and heritage, which is anchored in its Indigenous communities. It is important to know what a particular IKS consists of and how it is acquired, in order to use it (Hammersmith, 2007) in a TE classroom to Africanise EE.

The Technology Education subject is both a hands-on and mind-on subject (Mapotse, 2018), and the same goes for EE. The practical nature of Indigenous knowledge aligns well with Technology, enabling TE teachers to teach their learners to design indigenously informed solutions to technological problems (Gumbo, 2019) while considering the environment. What Hammersmith (2007, pp. 2-3) reported over a decade ago is still relevant to this day in noting that, 'indigenous people possess an immense knowledge of their environments, based on centuries of living close to nature'. In addition, EE and IKS promote practical activities that engage learners' hands and minds during the learning process in formal or informal educational settings. It was argued that some TE teachers rely on theory (Gumbo, 2016a), and approaching TE theoretically is unfathomable (Mapotse, 2018). From this observation, researchers argue that learners may find it difficult to link TE theoretical learning to EE and IKS if it is not connected to physical activities. A study by Yuying (2019, p. 14) found that during theory classes, teachers often ignore the visual display of physical objects, leading learners to not understand or master the content. Many schools across the African continent cite a lack of resources as an excuse for their poor teaching of Technology and for failing to Africanise EE. The literature review in this study will shed light on the topic. In many cases, there is a terrible lack of physical resources for teaching TE in poor, often rural schools in South Africa (Jita & Mokhele, 2008). However, in some of the poorest schools in the most isolated part of the country, learners have achieved remarkable things with very limited resources (Thompson, 2019). Thompson further supports the view that resources make learning exciting, so school resources should be affordable and relevant to the curriculum.

2. Literature review and gaps identified

2.1. Technology Education teachers' flexible pedagogy

The uniqueness of each learner's learning process demands that TE teachers be flexible in their pedagogy, bearing in mind that EE and IKS are integrated into the TE curriculum and are hands-on disciplines. Our understanding of the need to appreciate African traditional knowledge and the

important role it could play in the search for a synergistic approach to the current global ecological crisis, when integrated with other ethics related to environmental sustainability, is necessary (Obiora & Emeka, 2015). Research exploring a collaboration among EE, TE, and IKS is necessary to comprehend African philosophy, whilst drawing on certain facts from Western knowledge. Curriculum and Assessment Policy Statement (CAPS) further emphasises this argument.

2.2. The interrelationship between TE, society, and the environment

The Curriculum and Assessment Policy Statement on core TE content areas in Grades 7-9 states that, as learning progresses, learners must be made aware of the interrelationship between technology, society, and the environment. Wherever possible, learners should be made aware of different co-existing knowledge systems. They should become aware of indigenous intellectual property rights and learn how indigenous cultures have met their demands through specific materials and procedures (DBE, 2011, p. 10). Nevertheless, Gumbo (2016b, p. 110; 2017a, p. 138) criticises the statement for several reasons. The phrase “wherever possible” does not demonstrate a commitment to integrating indigenous technology and thus downplays the importance of doing so. Furthermore, the phrases “made aware” and “become aware” do not imply integration but merely aim to make learners aware of indigenous technology. Indigenous knowledge is integrated at a superficial level, as learners are not fully engaged with it; they are merely aware of it. It seems that the CAPS policy promotes IKS to some extent. Therefore, teachers need to delve deeper into the knowledge perspectives and practices of Indigenous people (Gumbo, 2017a). This may close the gap between the theory and the practice of IKS in TE and EE, respectively. Another problematic point from the statement is “have used”. This approach to integrating indigenous technology is unfortunate because it implies that these events only happened in the past (Gumbo, 2017b). This further exacerbates the downplaying of IKS in TE and EE. Thus, teachers could use this as a point of reference rather than something to be taught in the classroom. The literature review will systematically compare the two main educational terms (TE and EE) based on current research.

2.3. Comparative studies on TE and EE

Many scholars in both TE and EE have conducted research on various forms of teacher professional development, in keeping with the Western trend. Compared to other studies, relatively few focus on incorporating IKS in TE or EE. For instance, Kayira et al. (2022) in the USA conducted research on the responsibilities of decolonising EE, a co-learning journey for graduate students and instructors. The study reported that applying decolonisation factors was crucial and identified four key decolonisation factors: centring programs in Indigenous philosophies of education; privileging Indigenous voices and engaging Elders as experts; promoting Etuaptmumk/two-eyed seeing; and employing Indigenous ways of teaching and learning. In Sweden, Axel (2023) examined how Sámi culture and knowledge systems are reflected in TE at a Sámi school. The study demonstrated how traditional cultural artefacts can play an important role in TE and broaden understanding of the relationships among humans, culture, nature, technology, and history. Further, for EE in South Africa, Shabalala, Hebe, and Mnguni (2023) characterised curriculum leadership among teachers and school leaders involved in EE as a preliminary effort to understand the challenges facing EE. The study found that some EE teachers, school managers, and EE subject advisors do not understand the concept of curriculum leadership. In Hong Kong, Pavlova (2023) explored how indigenous technology can contribute to sustainability/sustainable development through green skills development in classroom settings. The study argued that case studies based on indigenous technologies can be effectively used in TE to make it ‘greener’. When combined with learner-centred teaching and learning practices, inclusion will help learners to develop creative solutions for sustainable development issues. Moreover, Ruggedhla, Fidzani, and Moalosi (2023) explored the importance of including Indigenous Technological Knowledge in the school curriculum from primary to tertiary levels in Zimbabwe to

enhance people's lives and make education more relevant to life. The study substantiated that Indigenous Technological Knowledge is more relevant to learners in local communities than modern technology. Furthermore, Matsekoleng and Hay (2025) examined South African preservice teachers' experiences with traditional environmental practices. The study revealed that South African preservice teachers know traditional environmental practices crucial to protecting and conserving the environment, and that these practices can be integrated with subject themes. Lastly, Musundire (2025) undertook a research journey into Indigenous vs. Eurocentric teaching methods: The place of Afrocentric games in the South African Primary School Mathematics curriculum. The study aimed to improve mathematical performance in an underprivileged setting. Through systematic literature review, action research, and action learning, it identifies Afro-centric games as effective activities for teaching basic Mathematics concepts. This study can be used by TE teachers to Africanise EE through IKS, as learners can relate to Afrocentric games.

The aforementioned researchers in TE and EE have contributed to both national and global scholarship and have used similar techniques and approaches to collect data. Most scholars have combined either TE and IKS or EE and IKS in their research studies. So far, little has been done to integrate all three fields (IKS, TE, and EE) into one study to Africanise the curriculum. In this study, the researchers aimed to fill the integration gap of Africanising EE through the IKS. It is therefore not easy to establish a counterbalance for this integration to give a balanced view. Maybe the researchers could be counted among the pioneers in this integration process. This study responds to the question: To what extent do Technology Education teachers Africanise Environmental Education through Indigenous Knowledge Systems?

2.4. From training to policy implementation, teachers are not encouraged to integrate Indigenous Knowledge Systems

Neglecting the integration of IKS into TE and EE leaves African institutions continually playing catch-up with Western technologies and systems (Moalosi, Marope & Setlathanyo, 2017). In addition to the argument, Gumbo (2016b, p. 106; 2017a, p. 140) points out that teachers' training does not develop TE teachers to integrate indigenous technology into their teaching. The researchers additionally indicate that teacher practice and teacher development workshops that do not consider Indigenous viewpoints demonstrate a lack of commitment to incorporating Indigenous technologies (Gumbo, 2017b). This leaves a gap in training TE teachers' pedagogical styles, which could make it difficult for them to mitigate environmental issues in an African way. The next section unpacks the problem statement.

2.5. Problem Statement

This study aims to examine TE teachers' efforts to Africanise EE through IKS. The literature revealed a lack of inquiry into how TE teachers Africanise the curriculum in EE through IKS. It would not befit to unpack the concepts of Africanising the curriculum without mentioning the decolonisation of the education system. The discourse on the decolonisation of the education system will not be complete without addressing the IKS phenomenon. Therefore, according to Mashabela (2017, p. 1), to Africanise means engaging in critical observation and challenging the power structures of Western education. The ultimate goal of the Africanisation of the curriculum is to experience the true humanity found in an African conceptualisation of ubuntu/botho. The curriculum has both principles and pillars that underpin it. Kwaira (2020, pp. 236-237) outlines the principles underpinning the curriculum as inclusivity, life-long learning, equity, fairness, gender sensitivity, respect for others (ubuntu/unhu/vumunhu/botho), responsiveness, balance, diversity, transparency, and accountability. With the pillars of the curriculum framework, Kwaira listed them as follows: legal and regulatory framework, teacher capacity development, teacher professional standards, infrastructure development, and the Centre for Education Research, Innovation, and Development. It is incumbent

on policymakers to consider both the principles and pillars of the curriculum when reviewing it to Africanise it. The SA curriculum underwent a unique transformation, with subjects such as EE and TE introduced and incorporated in 1997 and 1998, respectively. The implementation of Curriculum 2005 (C2005) formally introduced EE in the South African schooling system in 1997 (Mkhabela, 2017; Reddy, 2011), and TE was later implemented in 1998 (Gumbo, 2016a; 2016b; Vandeleur, 2010). Curriculum 2005 embraced IKS as enshrined in the Constitution of South Africa. The study aims to address the following research question: ‘Are TE teachers Africanising EE through IKS in their classrooms?’

Considering the above-mentioned, the curriculum introduced EE, IKS, and TE disciplines into the school syllabus over two decades ago, with a one-year gap between them. The curriculum is described as ‘what happens to learners for which the school is responsible’; it is imperative to incorporate IKS into the school curriculum, as it occurs within the school system, to enhance Indigenous and local technologies and modernise society (Hamilton-Ekeke & Dorgu, 2015). Regarding scholars’ ideas, IKS is a living body of knowledge passed down from generation to generation, whereas EE and TE curricula are taught through hands-on activities and book-based knowledge. This premise motivates this study to examine how far the researchers have come and the issues TE teachers face in Africanising the curriculum. The uniqueness of this study further lies in its possibility to Africanise the EE through IKS using TE teachers as a sample. The study supports the integration of diverse fields of study around a common goal of Africanising the curriculum. For TE and EE subjects to be considered appropriate for IKS, they must be underpinned by theories that provide the fundamental principles governing their coexistence.

2.6. Theoretical Frameworks

The purpose of this study is to investigate the extent to which TE teachers strive to Africanise the TE curriculum by integrating EE and IKS, guided by the cultural absolutism theory. According to the scholar, cultural absolutism is a philosophical position that holds a civilisation’s culture to be of paramount ethical significance. It promotes ethnocentric devotion to one’s cultural norms as a morally desirable attitude for everyone except those who are vaguely described as “Westerners” (Howard-Hassmann, 1993). According to cultural absolutists, culture is more valuable than the universally accepted (but Western-derived) notion of human rights (Howard-Hassmann, 1993). In this section of the theory formulation, the researchers will integrate all gathered information on the problem. The researchers intend to show how to Africanise EE so that the independent variable (TE teachers) responsible for the problem on the dependent variable (IKS) can be conceptualised and tested. Accordingly, indigenous people operate within the Ubuntu/Botho philosophy in their everyday activities, which promote respect, cooperation, and other values. Thus, the inclusion of the IKS in the school curriculum serves that human right.

The emphasis is on valuing IKS by applying the cultural absolutism theory to guide the learning of Africanising EE, taking into account the learner’s context and culture. Cultural absolutism theory views learning as culturally based, as learners are engaged in their immediate milieu. For instance, learners are engaged in indigenous activities, including games. Indigenous games offer an alternative to dominant cultures because of their ecological friendliness and their direct connection to cultural education within Indigenous environments (Matsekoleng, 2022). Curriculum can be Africanised, as indigenous people have considerable knowledge, including religion as philosophy, the African style of healing, the African style of art, African technology, and African languages. These aspects must be introduced in the education system (Wallner, 2005). The stated aspects provide opportunities to make the curriculum relevant to indigenous learners by integrating everyday life activities (Matsekoleng & Mapotse, 2023). Learners must be engaged by posing questions, participating in hands-on activities, and creating and modifying materials as necessary. EE focuses on teaching

learners about, for, and in the environment. These three categories of EE make learning and teaching methodologies flexible, as learning can take place in and out of the school, using different aids.

Cultural absolutism theory is not attributed to any one originator. This is a generic phrase for the belief that diverse cultures' conceptions and accomplishments are valuable and can be interpreted and assessed using a universal criterion. According to Bothamley (2004), cultural absolutism in psychology maintains that a psychological theory (such as IQ) created in one culture is equally valid in other cultural contexts. In TE classes, learners should feel equal to their teachers, irrespective of the teachers' cultural backgrounds, as they bring unique traditional knowledge to their classrooms that can supplement teachers' knowledge. This will provide a great opportunity to respect and learn about one another's cultures. Subsequently, this could facilitate teaching and learning within the school context, taking into account their unique cultures. With the appropriate sampling technique and data instrumentation, unique data is collected.

2.7. Focus of the study

The study focused on TE teachers' efforts to Africanise EE through IKS in their classroom lesson delivery. During colonisation, the colonial masters made sure that they undervalued or dismissed the knowledge, practice, and tradition of indigenous communities. For a long time, this has manifested as a lack of recognition, respect, or integration of IKS into mainstream systems such as education, science, and policymaking. The study with TE teachers was conducted to address the exclusion of IKS from education, the dismissal of traditional medicine, the ignoring of ecological knowledge, and the lack of representation in policymaking. These TE teachers were guided through the action research cycle to help them value EE as they integrate IKS. The following section outlines the study's research methodology.

3. Research Methodology

3.1. Sample technique

The study involved eight sample TE teachers from six schools teaching in the Senior Phase (Grades 7, 8, and 9) who served as interviewees, participants, co-researchers, TE teachers, or respondents. In this study, purposive sampling was used because only a few selected teachers teach TE in each school in the identified grades. These TE teachers can provide rich, in-depth information and insight related to the study's focus. The action research practitioners followed a 5-step process for purposive sampling: setting the research goals, defining the target population, establishing selection criteria, identifying potential participants, and recruiting and selecting participants. These schools operate across three villages, with each village having one primary and one secondary school. TE, as a subject, was sampled owing to its richness in indigenous technologies and sustainability content. Teachers teaching TE were subsequently sampled for this study. Further, it is most likely that learners from the primary school will attend the same high school in the same village, which makes it unique to explore the study problem, as the learners would have been taught by Grade 7, 8, and 9 teachers.

3.2. Research approach

Action research (AR) design is a cyclical process of research and action, typically used to solve practical problems (e.g., TE teachers not integrating IKS into their teaching) in a real-world setting (the TE classroom). AR involves identifying the problem, planning an intervention, and implementing the action, observing the effect, and reflecting on the results to refine future action. The AR practitioners chose this approach since it emphasises collaboration, participation, and iterative cycles of learning and change. AR, by its nature, presents unique challenges stemming from the research setting. One of the challenges experienced by researcher/AR practitioners was the TE teacher's departure from Village 1, where they worked at the Primary school. However, the TE teacher passed

away before the interview could take place, and his replacement was not available on the day of the interview.

3.3. Data collection methods

Data collected during one of the action research cycles from eight TE teachers is reflected in Table 1. The structured interview sessions were intended to collect data on TE pedagogy related to IKS and EE. Table 1 only displays TE teachers who were interviewed on the scheduled day of the session. The co-researchers were interviewed individually in a single cycle as part of a systematic effort to gather information to understand and improve a specific classroom practice. Two teachers at the Secondary school teach TE to both Grades 8 and 9.

Table 1. Interviewee population sample

School of the participant	Interviewee respondent		TE Grade being taught			Schools' villages and TE teachers interviewed
	Number	Code	Grade 7	Grade 8	Grade 9	
Primary School 1	Interviewee 00	IR 00				<u>Village 1</u> Only two teachers for the Secondary
Secondary School 1	Interviewee 1	IR 1		X	X	
	Interviewee 2	IR 2		X	X	
Primary School 2	Interviewee 3	IR 3	X			<u>Village 2</u> Two teachers at Primary and one at Secondary
	Interviewee 4	IR 4	X			
	Interviewee 00	IR 00				
Secondary School 2	Interviewee 5	IR 5		X	X	
	Interviewee 00	IR 00				
Primary School 3	Interviewee 6	IR 6	X			<u>Village 3</u> Two teachers in Primary and one in Secondary
	Interviewee 7	IR 7	X			
Secondary School 3	Interviewee 8	IR 8		X	X	
	Interviewee 00	IR				
TOTAL				8 (Eight)		

In Village 2, there are three TE teachers in Primary School 2 teaching Grade 7, but only two were interviewed; the other was not well on the day of the interview. At Secondary School 2 in Village 2, two teachers are teaching TE to both Grades 8 and 9. Only one was interviewed; the other teacher left the school earlier due to an urgent business matter and therefore could not attend the interview.

In Village 3, at Primary School 3, two TE teachers were teaching Grade 7. Both primary teachers from Primary School 3 were interviewed. In Secondary School 3, two teachers were teaching both Grades 8 and 9. However, only one was interviewed, and the other was offered a Departmental Head (DH) post at another school in a different village, which was outside the scope of the community engagement project.

In a structured interview, the researcher uses an interview schedule, a series of questions presented in a specified order (Bertram & Christiansen, 2020). Predetermined questions for the study arose from the gap identified in the literature review. They were further informed by the study's aim, which examines TE teachers' efforts to Africanise EE through IKS. The following constituted a set of predetermined IKS pedagogy questions posed to the TE teachers:

- What is your understanding of the phrase indigenous knowledge systems?
- Why does the Department of Basic Education value the inclusion of IKS in Technology Education subjects?
 - Are you infusing IKS in your TE teaching? Please support your answer.
 - What content are you covering in your IKS teaching during the TE classroom practice?
 - What are the learning activities you are using during IKS teaching?
 - As the TE teacher in your school, how do you assess IKS?
 - How do you use your local community to advance your IKS technology?

The total number of TE teachers participating in this community engagement action research project across the three villages was 13. Of the 13, only 8 were available for structured, scheduled interviews. The ensuing section discusses the research findings.

3.4. Data analysis process

Initial Coding (Open Coding)

The researchers used open coding to transcribe the responses on the interview schedule. Thematic coding, also known as conceptual or concept coding, is a form of content analysis, also known as thematic analysis (Babbie & Mouton, 2001, p. 493). Thematic coding is a data-reduction process that involves identifying themes (du Plooy-Cilliers, Davis & Bezuidenhout, 2014). The coding is based on the seven questions shown last under the section data collection methods in their logical and chronological order. The transcript excerpt and code are reflected in Table 2.

Table 2. Code emanated from the transcript (example)

TRANSCRIPT EXCERPT FROM THE INTERVIEW SCHEDULE	CODE
<p><u><i>IKS understanding:</i></u></p> <p>“Methods and ways which were used by the ancients”. “... is the method or way that was used by the origins”. It refers to knowledge and skills that were applied after that group discovered and invented them. “Ways of teaching using the knowledge of culture observed by learners”.</p>	<p>Ancient or original methods</p> <p>Knowledge and skills invented or discovered.</p> <p>Cultural knowledge observed</p>
<p><u><i>Why DBE value IKS in TE:</i></u></p> <p>“So that learners don't forget their values”.</p> <p>“All modern technology has a basis or an origin from old technology”. “In order for learners to know how ancient things were used to do things and practice those methods”. “To appreciate the history of scientific</p>	<p>Linking modern technology and ancient</p>

discoveries, technological solutions, and their relationship to indigenous knowledge and different worldviews”.	Appreciate the history of scientific discovery. Relating IKS and worldviews.
<u><i>IKS infusion in one’s teaching:</i></u>	
“Yes, when teaching, I made them aware of the interrelationship between technology, society, and the environment”. “Yes, when teaching, we discuss the processing, and the ways things were done in the olden days”. “Yes, when teaching processing, we discussed the ways that were used before by our ancestors”. “Yes, I use examples of what learners are exposed to”.	Infusion is being processed
<u><i>Content covered in the IKS teaching:</i></u>	
“Structures”, “Mechanical System and Control and Graphics Communication”. “Processing, Structures and Electricity”. “Benefits of technology and a bid of tools”.	Competency mainly in Structures and Processing
<u><i>Learning activities during IKS:</i></u>	
“Drawings are most important and even singing old and new songs”. “Projects, written work, working with tools”. “The learning activities, like pictures, video clips, and charts, show them the indigenous knowledge of the past, with the present”. “Discussion, Involvement, Drawings, Visualising”.	Drawings, projects, video clips, charts, and discussion.
<u><i>Assessing IKS:</i></u>	
“As a TE teacher, I used to assess the learners by giving them a task”. “Exams, classwork, and rubric for projects”. “We assess them by using a rubric to see whether or not they have a little knowledge of the past”. “Through projects”.	Task, examinations, classwork, and project rubric.
<u><i>Usage of the local community:</i></u>	
“I ask the local community elders to explain to their children about the lifestyle and technology of our forefathers, and the recent technology”. “Encourage learners to involve their folks at home to assist with their model project”. “We practice it on them, so that the historical knowledge must not be forgotten”. “Ask an old leader from the local community to explain some knowledge used during their time.	Asking elderly local community members. Community leaders invited to explain past IKS experience. Learners should ask their parents.

In Table 2, any interview transcript that has the same or a similar idea was not repeated. Some interview responses were similar or identical, and the table captures only the diverse ideas present in the transcripts. The transcript excerpt from the interview schedule was then coded.

3.5. Developing themes

Grouping similar codes into potential themes. Table 3 below indicates how the codes were clustered together to develop the themes.

Table 3. From codes to themes

CODES	THEMES
Ancient or original methods Knowledge and skills invented or discovered. Cultural knowledge observed.	IKS: past transferable practice
Linking modern technology and ancient Appreciate the history of scientific discovery. Relating IKS and worldviews.	IKS ontology
Infusion is being done under processing.	Processing as a favourite theme
Competency mainly in Structures and Processing	Exclusion of other TE themes
Drawings, projects, video clips, charts, and discussion.	Various IKS activities
Task, examinations, classwork, and project rubric.	TE assessment
Asking elderly local community members. Community leaders invited to explain past IKS experience. Learners should ask their parents.	IKS human resources

The next section unpacks the study's findings in relation to the developed themes.

4. Findings

Data were collected during the third term of the school year in weekly community engagement contact sessions with the TE teachers. The term in this study refers to the South African school terms for teaching and learning, consisting of four quarters, each comprising three months. The responses to the question statements put to the TE teachers during the structured individual interviews will be reflected in this section. Ethical clearance was sought from the host institutions of the AR practitioners. Ethical procedures were followed, with names concealed to protect participants' identities. Permission was sought from school principals and the provincial Ministry of Education. Furthermore, participants had signed a consent form to freely participate in this study. After securing a time slot with the TE teachers, per school, per village, the interviews were conducted.

1) Under the theme: **IKS: past transferable practice**

Teachers' understanding of IKS is crucial for teaching and learning to be subject-relevant. In addition, for continuous intergenerational learning, whether in school or at home, it is more appropriate and relevant to engage learners with their context during lesson delivery. As IKS practices and skills have been transferred from one generation to the next since time immemorial, mainly through imitation and observation.

Regarding the question *'What is your understanding of the phrase indigenous knowledge systems?'* Almost all of the sampled TE teachers seem to reflect their understanding of IKS very well,

as evidenced by the following response: “It is a set of traditional knowledge, skills, and technologies that a local or indigenous people practice.” (IR 8).

“Is the understanding, skills, and philosophies developed by societies with long histories of interacting with their natural surroundings.” (IR 2).

“They are bodies of knowledge, skills, teaching, and belief produced locally by people in their specific cultural communities and environment to maintain and improve their livelihood.” (IR 6).

Two TE teachers’ responses were somewhat concerning to the researcher, as they appeared to have little understanding of IKS. They failed to express their understanding of IKS in writing due to insufficient knowledge stemming from inadequate qualifications to teach TE. Further, the teachers may have underplayed the IKS or may not be exposed to it. The following are their responses to the question:

“It refers to something always available to be used all the time, meaning every day when the educator enters the classroom. She or he will be ready to help learners (IR 3).

It was when education was teacher-centred. Passive learners just wait for solutions or products. They are just learning to pass exams.” (IR 1).

For this question, most TE teachers understand the IKS, and their responses capture various elements of it. Their understanding is well-grounded as it covers the environment, society, and locality of the knowledge.

2) Relating to the theme: **IKS ontology**

Over the years, IKS ontologies have been grounded in the Botho/Ubuntu principle, which advocates cooperation and dialogue. As the say goes in Sepedi “Tau tša hloka seboka di šitwa ke nare e hlotša” (Lions that lack unity cannot even defeat a wounded buffalo). This emphasises teamwork through dialogue to overcome challenges and for survival. Including such practices or approaches in the TE will add value to the curriculum.

Regarding the question, ‘*Why does the Department of Basic Education value the inclusion of IKS in the TE subject?*’, the following responses were recorded:

“To promote integration of cultural knowledge in the curriculum.” (IR 7).

“DBE wants every learner to be involved and be developed with the necessary scientific and technological foundations needed in society, nature, and the environment.” (IR 5).

Only with (IR 1) and (IR 3) are their answers found wanting. Their responses were unclear, as they did not answer the questions in a way that showed understanding. TE teachers seem not to invest much in this field, which may be attributed to the phrases “*made aware*” and “*become aware*” in the DBE policy.

3) Pertaining to the theme: **Processing as a favourite theme**

Infusing IKS into TE lessons reveals learners’ prior knowledge and provides an opportunity for them to engage in learning. Most indigenous learners have been engaged in hands-on activities in their communities. For instance, using waste materials to play indigenous games. Therefore, it was important for the study to obtain teachers’ opinions.

Regarding the question, ‘*Are you infusing IKS in your TE teaching? Please support your answer, one teacher asserted by answering ‘no’, the other reiterated ‘sometimes’ as the answer, whilst the majority reported ‘yes’ as their answer.* The following responses, along with several others, illustrated how the teachers infused IKS into their TE teaching.

“No, because now I am encouraging learners who are the ears and eyes of their community to use electricity as a source of energy to stop the impact of wood as a fuel on their environment.” (IR 1).

“Sometimes, because of a lack of pedagogical knowledge to use science as an inquiry approach to teach IKS. Also, the textbook I used in class gives information on IKS in the form of examples; hardly any attention is given to teaching strategies and practical work that can be done in the classroom.” (IR 6).

“Yes, I provide examples around climate by using knowledge from indigenous knowledge or buildings used by IKS to support structural designs.” (IR 7).

Teachers’ responses lack a deep understanding of IKS and its application in their day-to-day activities. Their teaching aids do not help much with the IKS content.

4) Delving into the theme: **Exclusion of other TE themes**

Technology Education is a comprehensive subject that integrates various topics, including environmental content. Excluding some TE themes denies learners the opportunity to learn about economic, environmental, and cultural content.

Regarding responses from TE teachers to the question, ‘What content are you covering in your IKS teaching during TE classroom practice?’, it seems most teachers are comfortable covering the TE theme of structures and processing among the four TE themes. The following responses support the above comment:

“Recycling, impact, structures, emerging situations, and Technology investigation.” (IR 2).

“Emerging situations and Technology to solve problems and meet human needs when stranded in the neighbouring country or during an unexpected accident, house fires, and natural disasters.” (IR 5).

“Lighting, mud houses, preservation of food.” (IR 7).

The comfort of TE teachers in covering the structures and processes stems from the fact that these topics are not as demanding as chemical or mechanical topics (Matsekoleng, 2022) and are practical. Additionally, it is evident that TE teachers lack the qualifications and pedagogical styles to deliver TE lessons that integrate IKS and EE.

5) Focusing on the theme: **Various IKS activities**

Inclusion of various IKS activities broadens the scope of teaching and learning. Indoor and outdoor activities give a chance to relate the knowledge gained at school and at home. Excluding one of the activities limits learners’ learning experiences.

Pertaining to the question, ‘*What are the learning activities you are using during IKS teaching?*’, the following was outstanding: one TE teacher included the components of EE in the response, even though it was limited to education in the environment, whilst excluding education about and for the environment. The IKS learning activities include “Cleaning our environment, designing difficult structures, and designing emergency meals.” (IR 2). The other TE teacher simply put the IKS learning activities as “Classwork and Assignments.” (IR 7). IR 5 offers IKS learning activities such as “Investigate materials needed, textile materials, design brief for suitable textile, model, and sketch design.” IR 5 further states that a learner’s workbook, a teacher’s guide, and a TE policy document are used during this activity session.

In summation, TE teachers' learning activities are confined to the classroom, suggesting that teaching styles are teacher-centred. The activities do not promote IKS inclusion in their lessons but focus mostly on formative and summative assessments.

6) Handling the theme: **TE assessment**

Formal and informal tasks are meant to assess the outcome of the curriculum or lesson. Any type of assessment serves as a monitoring tool to identify knowledge gaps.

The TE teachers were asked, *"As the TE teacher in your school, how do you assess IKS?"*

Responses were as follows: IR 6 stated, "The policy document guides me, I do not assess IKS, I just give the learners informal and formal tests covering the whole topic". Only one out of eight has included the TE theme, "System and Control" in responding to the assessment question, with the response being as follows: "By giving learners Assessment Tasks, experiments, practicals, e.g., at the end of this term, learners will be able to make an electrical circuit". Many of the TE teachers proclaimed that they would use a rubric to assess, as expressed by (IR 1): "I use rubrics with criteria and marks. I explain everything to them so that they may have direction on what is to be done. For technological terms, they must explain and sometimes answer the given question." IR 2 simply stated, "Rubric is used for the PAT," while IR 7 said, "By employing memorandums, rubrics, and discussions."

Although IKS does not have a standard assessment framework based on TE teachers' responses, teachers had difficulty determining how to assess IKS. The assessments are more Eurocentric and do not accommodate the IKS. Indigenous Knowledge Systems assessment advocates hands-on activities through exploration, observation, and imitation of elders. TE teachers here missed opportunities to utilise indigenous games, processing techniques, etc.

7) Benefit of the theme: **IKS human resources**

Community members are the custodians of IKS; involving them in the TE lesson will expand the scope of teaching. Theoretical learning will be supplemented by IKS practices, such as engaging in activities within their communities. Researchers intend to understand how TE teachers utilise local communities in their practice.

In response to the last question, "How do you use the local community to advance your IKS Technology?", the TE teachers' responses varied in their interpretation of who the local community members are and how they engage them. Others regard the local community as parents, (IR) stated: "Assignments given to learners and ask learners to be aided by their parents. Planning investigation and identifying problems and issues around local communities." A few TE teachers drew our attention to the fact that the local community is synonymous with elders, as stated by (IR 7): "consulting with the elders, integrating the findings with the Technology curriculum". Unfortunately, others do not involve their local communities when addressing the IKS concept, as seen in the following response: "Honestly, I don't engage the community in IKS technology." This suggests that TE teachers do not regard the local community as part of their school community. The westernisation of the curriculum could be one factor contributing to the local community's exclusion from the school curriculum.

The themes that emerged from the TE teachers' responses revealed the status of the TE in schools and how teachers view EE and IKS practices. Teachers' responses also indicate that Western values dominate the school curriculum. The inadequacies of Africanising the TE are attributed to a lack of indigenous and EE knowledge. The exclusion of the local community might suggest that TE lacks relevance to local knowledge and technological practices (Odora, 2020). Furthermore, according to the study, TE teachers advocate for intervention by all relevant stakeholders to ensure that learning is grounded in daily life and societal contexts that construct conceptual knowledge, helping learners perceive the meaningfulness of TE, EE, and IKS (Gumbo, 2023). Teachers seem not to be enthusiastic about teaching TE, which integrates IKS and enhances their teaching with EE, as

defined in the introduction session. Unfortunately, the TE curriculum policy is formulated top-down. Most importantly, TE teachers must be equipped with the skills to teach across sociocultural barriers.

The collected data was typed into the computer program and afterwards coded. Upon completion of data entry and code assignment, the Ideas were categorised and grouped under the emerging theme. Thus, coded themes emerged from the data. Thematic coding is used in a thematic analysis of the text (du Plooy-Cilliers, Davis & Bezuidenhout, 2014, p. 241), as seen in the next section.

5. Discussions of thematic analysis

From the findings, the following themes were developed and are unpacked in this section: 1) Understanding the meaning and value of Africanising EE IKS in TE; 2) IKS infusion by relating TE themes during lesson delivery; 3) TE learning activities and assessment that relate to IKS and EE; and 4) Involving the community members as IKS resources.

1) Understanding the meaning and value of Africanising EE through IKS in TE

Understanding is a crucial part of the teaching and learning processes. Understanding the concept offers a glimpse into the extent to which teaching and learning will be effective. In this theme, many of the TE teachers understand what IKS is. In their explanation of IKS, the TE teachers touch on the following: traditional knowledge; skills and technologies; society's long history of interactions with its natural surroundings; cultural communities improving their livelihoods, etc. This confirms that TE and environmental themes are part of society's cultural system, values, and beliefs. Culture is a critical component of the teaching and learning process, as the environment strongly influences culture (Zimu-Biyela, 2019). Indigenous people have a long history of not harming the environment, as Indigenous philosophy fosters environmentally sustainable relationships with nature (Boyce, 2015). This is due to the coexistence and interdependence of technology, society, and the environment; for instance, the use of waste materials reduces environmental problems and environmental damage (Matsekoleng & Mapotse, 2023). Simply put, Technology and culture are like a finger and nail. There is a perfect relationship between TE and culture, and the designer is the one who combines the two (Moalosi, Popovic, Kumar, & Hudson, 2005).

The introduction of TE into the South African curriculum was prompted by the need to create a technologically literate population for the modern world and to generate engineers, technicians, and artisans—all of whom are needed in today's society (DBE, 2011). As teachers groom and develop technologically and environmentally literate populations for the modern world, they should cultivate learners' awareness of environmental factors as they prepare them for technical career paths in the environmental sciences. The Department of Basic Education (2011, p. 5) draws attention to the 'valuing Indigenous knowledge systems: acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution' and hence, TE teachers should Africanise EE. Most TE teachers seem to understand why the national education ministry values IKS in TE.

2) Indigenous Knowledge Systems infusion by relating Technology Education themes during lesson delivery

Infusion is a way of integrating different subject areas into a single lesson to make it more relatable. However, the infusion requires competent teachers. For this reason, teaching is more complex than ever, owing to political, economic, and social issues in our society. The researchers require teachers who are thoughtful, flexible, technologically savvy, competent, innovative, resourceful, enthusiastic, team players, and aware of learner diversity and learning styles (Hoban, 2005). The aim of engaging TE teachers in community engagement activities was to produce this type of teacher described by Hoban. To date, the TE teachers are not yet confident enough to infuse IKS into their TE themes during lesson delivery. This is based on the responses they gave, which range

from “no” to “sometimes”. The “no” to “sometimes” highlights that the TE curriculum is not fully implemented in South African schools. The TE curriculum and teaching that do not integrate IKS risk dampen Indigenous learners’ enthusiasm for studying Technology (Gumbo, 2019). An additional risk is the loss of indigenous technologies and IKS values for future generations.

It is a worrying factor that the majority are not integrating IKS into lesson delivery, despite the policy urging them to do so. The technology policy document (DBE, 2011, p. 10) gives teachers a certain amount of leeway in infusing IKS into their teaching, stating that, “Wherever possible, learners should be made aware of different coexisting knowledge systems. They should learn how indigenous cultures have used specific materials and processes to satisfy needs and become aware of indigenous intellectual property rights.” Even though the policy urges TE teachers to try to transfer Indigenous culture to their learners, teachers, unfortunately, are not doing this, as alluded to above. It seems most TE teachers excel in the TE theme of structures; however, only one TE teacher is comfortable with electrical systems as a best practice within that theme. In her study, Zimu-Biyela (2019) underscored that “IKS is entrenched in curriculum policies; putting theory into practice is a challenge”. The practicality of TE is a challenge in the South African curriculum (Vandeleur, 2010).

3) TE learning activities and assessment that relate to IKS and EE

Activities are tasks given to learners, whether formal or informal, to consolidate the learning objective, while assessments test the knowledge learners have gained from the activities. The activities and assessments pose a challenge for teachers who are not sufficiently competent to accommodate Western and African curricula. For teachers to integrate EE, they need to be well-trained, competent, and experienced (Hebe, 2021). Indigenous learners around the world have been disenchanted with the experience of conventional schooling, not because of low innate intelligence, lack of ingenuity, or even problem-solving skills, but because of the alien school culture they encounter (Barnhart & Kawagley, 2005). Technology Education has evolved over 50 years from a skills-based school subject that focused on using tools and making products, to assisting learners in future employment through both technological problem-solving and design skills (Ritz & Bevins, 2016).

It’s the TE teachers’ role and core business to be inclusive when giving their learners TE learning activities. The learning activities that TE teachers give to their learners are quite diverse and include, but are not limited to, classwork and assignments, investigations of different materials, and the use of workbooks. The teachers use a variety of techniques and tools to assess these learning activities. However, these activities are limited in their pedagogy to embrace education about, for, and in the environment. Moreover, their tasks indicate that teachers faced challenges in implementing ‘indigenous technology and culture’ in their classrooms (Vandeleur, 2010). Environmental Education and TE in nature advocate active activities. Technology Education teachers should integrate indigenous technology and culture because this is part of the curriculum and encourages them to contextualise and Africanise the TE curriculum (Mapotse & Gumbo, 2019).

4) Africanising EE by involving the community members as IKS resources

Africanising refers to the inclusion of indigenous practices in the curriculum. Africanising the curriculum could pose a challenge for teachers who are not skilled. Technology Education teachers should embrace the African Renaissance agenda, as this will encourage learners to take pride in both their past and their future and to appreciate their environment. Africa offers worldviews (ontologies) and knowledge systems (epistemologies) that have the potential to significantly transform both theory and practice (Phillips, 2017). The Africanisation or decolonisation of TE as a school subject has an agenda that far exceeds mere importation into Africa (Mapotse & Gumbo, 2019). The starting point is to Africanise the whole TE curriculum to include IKS. Africanising the curriculum is a call for

African countries to reflect on their own cultures, identities, languages, and histories in their curricula (Gaotlhobogwe, 2012; Moalosi, 2007).

Du Toit (2019, p. 111) suggests that Africanisation does not mean that Western knowledge systems are invalid, but that African or IKS is also valid and deserves acknowledgement. In the usual Africanising EE structure, teachers teach, and action research practitioners observe and offer a list of areas for growth. Changing the design to allow teachers to self-assess and self-reflect makes the process of Africanising EE more meaningful. Teachers are motivated to learn and invest in their development when they have a teacher-driven professional plan (McCullough, 2020). With action research, TE teachers serve as co-researchers and, therefore, are expected to jointly act to Africanise EE. Local community elders could be incorporated into the process of Africanising EE. It is argued that holders of traditional knowledge within the community, who are knowledgeable about herbs used for traditional medicine, could help to pass on their knowledge to teachers and learners in the school (Alaribe, 2015).

6. Conclusion

This study examined TE teachers' efforts to Africanise EE through IKS. The TE and EE subjects have a role to play in the school curriculum. The integration of IKS in these subjects ensures that the curriculum is decolonised and Africanised to accommodate Indigenous learners. The integrated curriculum will include ways of knowing and doing that are learned from the community of elders. However, the effectiveness of these subjects depends on teachers' pedagogical approaches and ongoing in-service training.

In this study, it was emphasised that TE teachers' methodologies are limited to adopting IKS and EE philosophies. The more teacher-centred approaches, which embrace textbook-based assessment and are confined to the classroom, are therefore exclusionary of local communities. All three learning areas, namely, EE, TE, and IKS, are practical disciplines that advocate learner-centred approaches. For instance, EE teaches learners to learn about, for, and in the environment, and TE teaches learners about active design and processing, whilst infusing indigenous technologies. Therefore, learning depends not only on the presentation of material but also on the cultural process of learning, which is anchored in experiential techniques (Boyce, 2015).

It seems TE teachers spend most of their time teaching one theme (structures), based on their responses. Technology Education consists of four main themes: processing, structures, systems, and control. The exclusion of other themes and inadequacies denies learners the opportunity to learn freely. Although TE teachers understand IKS, this does not translate into fairness in covering IKS lessons within the stated TE themes for each term of the academic year. Hence, they integrate IKS "sometimes", or they do not integrate it in their lesson as required by the CAPS policy.

The incorporation of IKS into EE and education is essential for several reasons. For instance, it can help the indigenous community address gaps in its understanding of the environment, enabling it to counter existing environmental challenges (Nesterova, 2020). Against this background, the exclusion of IKS from the TE curriculum could result in learners failing to acquire adequate traditional environmental knowledge. Insufficient environmental knowledge leads to a lack of environmental awareness about environmental issues (Matsekoleng, 2017).

Based on the aforementioned discussion, the researchers conclude that TE embraces IKS and EE, but TE teachers to date have struggled to integrate these disciplines effectively. Hence, TE teachers hand-pick topics that they are comfortable teaching. This could be attributed to their level of training, work experience, and subject content knowledge (Hebe, 2021). A lack of resources and support hinders TE teachers' lessons, and they resort to teaching topics that are easy to teach (Matsekoleng, 2022). Moreover, their assessments are situationally based, and hence, indigenous learners are

denied learning about their immediate environment and indigenous technologies, which have implications for teaching and learning. This leaves a gap in learners' learning. Teachers are therefore required to use practical activities to deliver lessons that integrate the disciplines' synergies.

It is recommended that the following should be taken into consideration to ensure TE delivers its mandate:

- A dedicated workshop focusing on the Africanisation of TE content must be attended by TE teachers to discuss ways of integrating IKS and EE in the TE curriculum to ensure teachers are fully equipped with flexible teaching styles. This ensures that learners perceive themselves in what they learn and the manner or strategies used to learn it (Gumbo, 2020).
- Flexible annual Teaching Plans (ATPs) must be provided that allow teachers to explore teaching spontaneously; and
- Technology Education teachers must include parents when they plan their lessons to ensure IKS values are integrated effectively.
- Higher Education Institutions (HEIs) should continue to involve TE teachers with community engagement or Engaged Scholarship and Societal Impact activities. These activities should guide and emancipate teachers to integrate IKS whilst considering EE.

Declarations

Statements and Declarations. The researchers declare no conflict of interest.

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