

Epistemic Journeying across Abyssal Lines of Thinking: Towards Reclaiming Southern Voices

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Abstract

Cognitive injustice, which nourishes and sustains current political, social and economic injustice, has been at the centre of the knowledge production enterprise since the colonisers embarked on their project of dispossession and plunder. In order to achieve global justice, the quest for epistemic justice needs to be brought to the centre of curriculum discourses. The postcolonial critique of the canonical corpus of Euro-Western knowledge demands a change in our locus of enunciation. We seized this *zeitgeist* to repaint the education curriculum canvass in science professional teacher development. We leveraged theoretical constructs from Southern theory, by adopting a decolonial epistemic perspective and privileging a dialogic dynamic. Six purposefully selected, practising science teachers, who were registered to study an Honours in Education module, were engaged to generate qualitative data to respond to the following question: How do science teachers leverage indigenous knowledge to address sustainable development goals? Teachers engaged in intercultural dialogue with indigenous knowledge holders to tap into a plurality of different knowledges. The indigenous knowledge holders who participated were interested in sustainable production/cultivation of items they had used in their practice. Teachers developed portfolios of evidence and participated in focus group interviews. They experienced moments of mourning, dreaming, rediscovery and recovery. This resonated with the same categories that were previously identified by Chilisa, as teachers deconstructed

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and reconstructed curriculum materials collaboratively with indigenous knowledge holders. The findings reveal that the teachers viewed an indigenous understanding of the world as crucial in the achievement of sustainable development goals. The monolithic, hegemonic Euro-Western thinking was decentred but not abandoned. Instead, teachers rendered it one part of the intercultural dialogue. The study demonstrated the potential for transforming the curriculum to become inclusive of Southern voices in the production of valuable, truthful, reliable knowledge about living together sustainably.

Keywords: curriculum transformation; decoloniality; indigenous knowledge; intercultural dialogues; Southern theory

Introduction and Background

The production of knowledge during this era of neoliberal globalisation is characterised by economic injustice, political injustice and cognitive injustice, which are interdependent and sustain one another (Barreto 2014). The critique of these injustices is at the heart of emancipatory discourses, which underscore intercultural dialogue about Western and non-Western understandings of human rights (Barreto 2014, 395). These dialogues shed light on the European colonial roots of the African higher education landscape, which persistently nourish the modern African university identity to serve as a native vanguard of civilisation, decades into the postcolonial era (Mamdani 2018). The effects of the dispossessing acts of colonialism are experienced by a majority of students in the global South, whose access to and success in higher education are stifled by financial deprivation and cultural capital deprivation. This lived experience of students has revived the call for decolonisation in South Africa, which gained momentum with the “Fees Must Fall” (Heleta 2016), the “Rhodes Must Fall” (Knudsen and Andersen 2019) and then “Science Must Fall” (Harris 2021) movements, and extended to other issues such as curriculum, which is central to education.

The call for decolonisation in education recast the gaze of scholars towards methodologies and ideologies emanating from global South contexts. Central to this decolonial intent is the idea of relational ontology, which focuses on the connectedness of human beings with the earth, land, cosmos, other beings, plants and animals. Within this ontological positioning the Euro-Western “I think therefore I am” (Goduka 2000, 73) is displaced in favour of the African “I am because we are” (Le Grange 2016, 9). The latter way of being human affirms others and allows for an understanding of one’s locus in relation to belonging to and sharing and participating within a greater whole. This epistemic journeying leads to exploring relational epistemology, which seeks to acknowledge all sources of knowledge, within their historical and sociocultural contexts, as valuable and worthy of dialogue. Epistemological diversity is at the heart of relational epistemology. Navigating beyond familiar epistemological boundaries generates broader epistemological frameworks, which can be accomplished through relational indigenous methodologies (Chilisa, Major, and Khudu-Petersen 2017).

These methodologies privilege collaboration, legitimise indigenous knowledge (IK) as being useful, and create spaces for cultural survival and cultural revivalism. They make marginalised identities visible and restore previously neglected value systems.

These understandings of ontological, epistemological and methodological positioning within the relational paradigm, during the era of revival of decolonial debates, have implications for university and school curricula in Southern contexts. Borrowing from Morreira and Lockett (2018, 4), we conceptualise curriculum as a complicated ideological discourse that is underpinned by “implicit ways of knowing, ways of doing and ways of being”. Extending this curriculum discourse is particularly significant within the contemporary education landscape, which has reverberated with students’ demands for recrafting the curriculum to suit the culture and ways of knowing of people from the South. Southern ways of knowing are underpinned by a consciousness of human beings’ connectedness to the earth. In order to journey across abyssal lines of thinking (De Sousa Santos 2007), we sought to reclaim Southern voices in the teaching and learning of sustainable development goals (SDGs). Adopting a decolonial perspective, we formulated the following research question, which is central to this article: “How do science teachers leverage IK to address sustainable development goals?”

In pursuance of an inclusive perspective, teachers in our study collaborated with IK holders to locate “intersecting domains of overlapping strands” (Zinyeka, Onwu, and Braun 2016, 257) between IK practices and school science. Unlike the teachers in the study by Zinyeka, Onwu and Braun (2016), teachers in our study began by understanding the processes, products and significance of cultural practices. Thereafter, they looked for correspondence and practical application, similar to pragmatic theory (Zinyeka, Onwu, and Braun 2016), with content and processes from school science. The centring of a cultural practice located within an indigenous knowledge system (IKS) was a deliberate move towards decolonising the curriculum. A review of decoloniality, sustainable development and the place of IK within the Southern university curriculum follows.

Curricula, Decoloniality and Sustainable Development

African nations are largely free from political colonisation, which was characterised by political control over and forcible occupation of their countries through dispossession of indigenous inhabitants (Uleanya, Rugbeer, and Olaniran 2019). Coloniality links modernity with dispossession, enslavement, genocide, and epistemic violence, which are the legacies of colonisation (Quijano 2000). The era of colonisation left in its wake colonial relations of power in many areas including human identity, knowledge, and the economy. Maldonado-Torres (2011), cited in Dirette (2018), refers to these as the coloniality of being, the coloniality of knowledge and the coloniality of power. The coloniality of knowledge is characterised by valuing and legitimising knowledge that is spawned and elevated within particular sociopolitical and temporal spaces of European modernity. Indigenous and traditional knowledge

systems are marginalised and devalued within this context. The dismantling of relations of power and conceptions of valuable knowledge, through the revival and recovery of indigenous knowledge, has been a part of decolonial discourses, which are relational, contextual and multiple (Mignolo and Walsh 2018).

We adopt a decolonial lens and imagine possibilities for the university curriculum based on the aforementioned understandings of ontological, epistemological and methodological positioning within the relational paradigm. We lean on Le Grange (2014) who draws from Pinar (2011) and Wallin (2010) to conceptualise curriculum as *currere*, and who proposes that scholars “think of the curriculum as an active conceptual force” (Le Grange 2014, 1287). Dominant Western constructs informing epistemology and methodology restrict the active force of *currere* by inhibiting its capacity for creativity. Le Grange introduces the concept *Ubuntu-currere* (Le Grange 2016, 9), which transcends restrictive boundaries and promotes creativity in a way that enables sustainable union of individuals with the human and non-human environment. *Ubuntu-currere* allows for framing a pedagogy that can respond to the clarion call for transformation in South African higher education by including varied voices on democratic thought (Le Grange 2019).

Padayachee, Matimolane and Ganas (2018, 288) underscore the need for “curricula to be adapted to better prepare graduates for current and future uncertainties ... [and] to include more explicitly the critical issue of sustainable development (SD) in all university curricula”. A decolonial approach to the curriculum and an Education for Sustainable Development (ESD) are necessary for institutional and broader societal reform and well-being, and both imperatives may potentially be achieved by focusing on principles of epistemically diverse curricula (Padayachee, Matimolane, and Ganas 2018). Tikly (2019, 223) argues that if education is to “play a transformative role in relation to SD then education policy needs to be fundamentally reoriented and address processes of economic, cultural and political transformation in the interests of social and environmental justice”. This is crucial in the global South, which we conceptualise within a geopolitical frame and includes countries where coloniality persists long after the colonisers’ flags have been lowered. Impoverishment, under-industrialisation and a history of sociopolitical oppression characterise these countries (Bulhan 2015). Within a global South context, education in general and ESD in particular need to be rethought on the African continent (Maringe and Ojo 2017). African education needs to look towards Africa first and foremost to confront its inherent challenges of poverty and underdevelopment and reimagine a new identity (Maringe and Ojo 2017).

A Case for Bringing Indigenous Knowledge to the Fore

Le Grange (2014, 1280) refers to

[t]hinking Africanization of the university curriculum as an immanent plane [which] implies flattening hierarchies—the smoothing of space that will create unpredictable and creative flows from university to/from communities—flattening of hierarchies

where one knowledge system is not viewed as superior (Western) and another as inferior (indigenous).

We extrapolate this idea to prevailing knowledge hierarchies that inform the school curriculum. We build on the idea that IK plays a vital role in the education and socialisation of many previously colonised populations, which constitute the global South (Takayama 2016). Indigenous knowledge systems should build a method of critiquing the current imposed European paradigms of rationality and modernity (Matiwane 2017). Mignolo (2011) believes IK helps one to understand the Southern project, which, according to Matiwane (2017), encompasses more than addressing the remnants left behind by apartheid. Imperialism, poverty, loss of land and inequalities are some of the challenges often attributed to the legacy left behind by colonisation and apartheid (Heleta 2016; Mudaly 2020). The inclusion of relevant IK epistemologies and Euro-Western epistemologies in the curriculum will form the basis of the way plurality of knowledges will be embraced.

Southern Theory

In our study, the conceptual affordances of Southern theory are leveraged in the science curriculum to address the SDGs by including IK as an alternative framework to inform research. We do this in pursuance of a decolonial epistemic politic. Southern theory is relevant to this study because it focuses on the knowledge generated from Southern intellectuals' critical engagement with Northern theories (Takayama 2016).

Southern theory, which evolved from contestations over the hegemony of the global North (as delineated by the Brandt line based on sociopolitical, geographical and temporal contexts), is at the centre of numerous theoretical and methodological debates in education scholarship (Connell 2017; Takayama 2016). Within the South African context, apartheid and colonisation served a geopolitical purpose and exacerbated oppression from the global North (Molefe 2016). Southern theory involves inviting previously disenfranchised nations to venture into the unfamiliar intellectual world that sits outside the academic centres of the "West" to broaden their epistemic horizons (Takayama 2016). It encourages the exploration of alternative research methodologies in education (Takayama 2016).

In *doing* Southern theory, we borrow insights from De Sousa Santos (2007) and transcend the abyssal line of thought that emphasises bias favouring epistemological dominance and legitimacy of established "canonical corpuses of knowledge" (Barreto 2014, 398). We do not deny the global margins of division between ideas from the North (deemed to be universally accepted and truthful) and ideas from the South (deemed as simple opinions, as ideas applicable only to local settings in which they originated, from people who cannot fully participate in legitimate knowledge production, as explained by Connell [2007], Chen [2010] and others). We gravitate towards De Sousa Santos's "post-abyssal way of thinking" (Barreto 2014, 395), which involves the search for ancestral knowledges and knowledges about how to live

together sustainably. In this scenario, Southern voices play an active role as agents of production of valid knowledge. Southern voices are deemed worthy of scholarly pursuit and dialogue. Intercultural dialogue where indigenous experiences of the world have a place, together with Western thinking being included among a plurality of different knowledges, as alluded to by Le Grange (2014), is embraced in our study.

Methodology

Our work was informed by a relational indigenous methodology that privileges Southern voices and collaboration with previously excluded communities (Chilisa, Major, and Khudu-Petersen 2017). This methodology is suitable because it emphasises the restoration of previously invisibilised identities and value systems. Directed by a decolonial agenda, it casts IK as a body of knowledge that is worthy of scholarly enquiry. This methodology underscores the preservation, restoration and protection of local knowledge.

A qualitative approach, which underpinned this participatory study, was suitable because, according to Creswell and Creswell (2017), a participatory study requires substantial involvement of teachers and community personnel (these include IK holders in our study). We adopted a participatory design to explore how teachers leverage IK to address sustainable development goals. We report on part of a larger project in which 20 science and mathematics teachers studying an Honours degree in Education at a South African university had engaged. In this article, we explore how six science teacher participants collaborated with IK holders to assist them in achieving the outcomes of the module. These teachers expressed the greatest interest in curriculum development and dialogues related to decolonisation debates. According to Check and Schutt (2012), six people are a manageable number for focus group interviews (FGIs) to engage in critical dialogue. Purposive sampling was used to select the in-service teachers who were registered for an Honours in Science and Mathematics Education programme. The teachers grouped themselves according to the school subjects they had taught.

Group 1 comprised three black, male, Life Sciences teachers, who were Lee, Shabba and Gift, as well as a female IK holder who selected the pseudonym “Imbokodo”. *Imbokodo* is the Isizulu word for a “rock”, which Africans use to denote a strong, resilient identity. Imbokodo was an African *Isangoma* (diviner) who was the designated ceremonial *umqombothi* (African traditional beer) producer in the community, and valued sustainable cultivation and harvesting of plants for food and traditional ceremonies.

Group 2 comprised Natural Sciences teachers and an IK holder. The group included one Indian, female teacher, Essy, two black male teachers, Sbu and Thobisa, and a female IK holder, Amandla. *Amandla* is the Isizulu word for “power”. Amandla was a local farmer who subscribed to sustainable farming methods, and was a valued elder

who was known by the community to be a repository of IK. Details of development of teacher capacity to adopt a decolonial approach follow.

Teacher Capacity Development

Teacher consciousness and capacity to critique curricula were enhanced in several ways. Professional development activities included interactive lecture presentations, self-study using prescribed reading material (including policy documents and peer-reviewed articles), responses to video clips, and role play, as these related to the following broad topics: (1) decolonising the curriculum, (2) curriculum development and transformation, (3) curriculum, sustainable development goals and IKS, and (4) critical theory and critical discourse analysis. Teachers were then given the following task (which is partially presented) to engage them in curriculum development driven by a decolonial intent:

Interrogate policy documents (CAPS) and textbooks to develop a unit of work on sustainable development which clearly illustrates the following engagement with a unit of work in the curriculum:

- Critically examine the content and pedagogy and locate a topic which can be used to teach at least one sustainable development goal.
- Address contemporary challenges related to Sustainable Development such as poverty, food insecurity, disease, environmental degradation, emission of greenhouse gases, pollution, among others, as detailed by the Sustainable Development Goals (SDGs).
- Incorporate IK into the topic/unit. Engage in collaborative learning with peers and Indigenous Knowledge holders.

You are required to develop a Portfolio of evidence which includes:

- A written account of (i) why you selected particular SDG(s), and (ii) how you leveraged IK to address Sustainable Development Goal(s).
- Development of a unit of work using a decolonial lens. This includes selecting a topic, grade, specific aims and knowledge strand, a description of what and how you will teach, a description of learner activities, highlighting integration of IK and addressing SDGs.

Data Generation

Teachers collaborated with IK holders to deepen their content knowledge and to provide insight into how curriculum themes could be contextualised for culturally diverse learners. Teachers participated in focus group interviews and compiled portfolios of evidence. Focus group interviews were a useful qualitative method that encouraged discussion among participants on the topic of interest (Check and Schutt

2012). Sim and Waterfield (2019) locate focus group interviews somewhere between a meeting and a conversation where individuals pick up on one another's contributions, which is consistent with the collaborative dynamics of this study.

Portfolios of evidence (POEs) were subjected to document analysis. Gibbs (2018) mentions that document analysis involves the study of documents to understand substantive content or to express deep meaning. Portfolios of evidence have been widely used to track evidence of their learning, reflect their evaluation, and promote self-directed learning (Song 2021).

Teachers presented selected ideas about content and pedagogy related to achieving SDGs by including IK, which had been detailed in portfolios of evidence during micro-teaching. They also presented excerpts from their engagements with the IK holders. Micro-teaching is an organic professional development process whereby teachers explained their critique of the unit of work they selected using critical analysis (deconstruction), and then presented the reconstruction of the unit of work. Remesh (2013) states that micro-teaching is a teacher training technique that provides teachers an opportunity to develop their teaching skills within a practice context before implementation within a formal classroom. Micro-teaching sessions were subjected to observation. Observation, according to Communications for Research (n.d.), is a research method designed to watch behaviour as it organically and spontaneously unfolds in a natural environment. Observations of micro-teaching sessions enabled a deeper understanding of teachers' behaviour and strategies related to *doing* decolonisation by leveraging IK to address the SDGs.

The data obtained from these multiple sources was analysed thematically.

Data Analysis and Findings

Thematic analysis was used to recognise and analyse patterns of meaning in the data, which were then coded into different categories and themes (Gray 2013). Inductive reasoning was subsequently adopted to find meaning from specific observations and analysis from which conclusions could be drawn (Feeney 2017). Symbols were used to denote the source of data, for example, POE1 is Portfolio of Evidence from Group 1, OS 2 is the Observation Schedule used to record information from micro-teaching presented by Group 2, and FGI refers to Focus Group Interview.

The first set of data and analysis is referred to as Part A and relates to teacher interviews before they engaged in the curriculum development task. This is followed by separate descriptions of data generated by each group from observations of micro-teaching presentations and portfolios of evidence. Part B represents data from Group 1 and Part C from Group 2. The first level of analysis was done using the following themes: Deconstruction of Curriculum Materials, Teacher Learning, and Reconstruction of Curriculum Materials. This linearity is intended for ease of reading,

but each of the three processes evolved iteratively. Part D includes deeper level analysis and discussion.

Part A

The first focus group interview took place before the teachers had completed POEs and presented their micro-teaching lessons. A major theme identified in these FGIs was “Mourning”, which is identified by Chilisa (2012) as an important stage of the decolonisation process. Teachers were asked the following questions: “What does colonisation mean to you? Who were the colonisers?”

Gift from Group 1 expresses his mourning through the following response:

They [colonisers] brought their religion and their knowledge and subdued the views and ideologies of black people, often using violence and fear as means. Colonisation influenced peoples’ education by political means, making everything colonial seem right and everything indigenous seem wrong. (FGI)

Lee indicates:

I think it was also an invasion of culture, not only land, and it was political control over indigenous people and yeah it definitely influences how we currently learn because as it was said it is like 20 years later and we are still feeling the effects of it in our education system. (FGI)

Loss of religion, loss of ideologies, loss of land, loss of culture—an overwhelming sense of loss together with a heavy sadness were evident during the focus group interview. Violence and fear during colonial plunder, the effects of which reverberate in current times to deepen the suffering of the historically colonised people, were also mourned.

Teachers were asked: “In your view, what role does colonisation have to play in science education?” Essay from Group 2 responds:

Science subjects that are so important to a country. It is so important for our countries, especially developing nations, to progress scientifically, but if these subjects continue to be colonised, what hope do our students have? It is not relevant to them, there is no hope. So, we need to change it. (FGI)

Thobisa, responding to the same question, states:

It creates the impression that the western people are like God of science and then whatever that we do we have to pass by them, and it creates this false idea that as Black people if I may put it like this, or African people, we are unable to think for ourselves and do anything for ourselves. (FGI1)

Teachers’ consciousness of the superiority of Western science, where Westerners are positioned as “God[s] of science”, was clear. Teachers mourned the notion that African people are deemed to be incapable of independent thought. The comment, “whatever that we do we have to pass by them”, reminds one of the cultural imperialism around the politics of vaccines during the Covid-19 pandemic (Mariwany and Ware 2022). New variants of the virus, which were uncovered by South African scientists, had to be verified by Northern scientists before these were accepted as valid findings.

Part B: Data from Group 1

GROUP 1: Example from the Life Sciences Curriculum

Table 1: Summary of micro-teaching presentation by Group 1: Life Sciences

| Grade Unit of Work | IK Content | Towards Indigenous Pedagogy | SDGs |
|--------------------------------|--|---|---|
| Grade 11: Cellular Respiration | a. Fermentation: <i>umqombothi</i> /kefir; b. Role of heat from the sun; c. Indigenous agricultural practices: crop rotation and inter/mixed cropping. | Inviting an IK holder into the classroom; Narrative pedagogies. | SDG 1: No Poverty; SDG 15: Life on land. |

Source: OS1

Deconstruction of a Unit of Work in the Curriculum by Group 1

Group 1 critically analysed the Life Sciences unit of work “Cellular Respiration” in the CAPS document.

| | | |
|---|--|---|
| <p>Total 7½ weeks (34 hours)</p> | <ul style="list-style-type: none"> - Anaerobic respiration: production of lactic acid in muscles during exercise; words and symbols (<i>no biochemical detail of process is required</i>); - The role of anaerobic respiration in the industry, e.g beer brewing and bread making. <p>A comparison between aerobic respiration and anaerobic respiration in terms of raw materials required, products and relative amounts of energy released.</p> | <ul style="list-style-type: none"> - provide relevant data that can be interpreted by learners. Identify variables, suggest controls for variables and record observations |
|---|--|---|

Figure 1: Extract from Life Sciences CAPS document on cellular respiration (DBE 2011, 45) (POE1)

Their analysis underscored the focus on industrial products of anaerobic respiration. They emphasised that African indigenous practices involving anaerobic biochemical pathways, such as making “steam bread” or *umqombothi*, were marginalised in the prescribed school curriculum.

Group 1 then engaged in critical analysis of textbook materials.

Lee, Shabba, Gift and Imbokodo note the following Euro-Western bias in the *Oxford Successful Grade 11 Life Sciences* (Bezuidenhout et al. 2012) prescribed textbook.

In the textbook, examples of the making of red wine are Western practices. According to history, the fermentation of wine began in Georgia and Sicily. Western scientists and contexts are foregrounded. Fermentation and cellular respiration are explained in the context of Euro-Western technologies. Fermentation of red wine in an industrialised manner is a Western practice and this unit does not incorporate African IK. (POE1)

Observation of their micro-teaching activity revealed the following insights by Group 1:

Energy expensive techniques in Western beer/wine making processes are highlighted. The wine industry at large perpetuates climate change. Wine is stored in wooden barrels which are made from cut down trees which negatively affects biodiversity and oxygen yield. The wine is transported using fuel-powered, carbon emitting vehicles, stored in chemically infused glass and plastic packets in boxes, and plastic is not biodegradable. Packaging materials and cost of transport and storage make commercially produced beer more expensive and require more raw materials. In the production of “umqombothi”, only a small amount of the beverage is produced at a time for a specific traditional ceremony. It is stored and consumed in a “Calabash” which is made from the hard shell of a fruit from the gourd family “*Langenaria siceraria*”. The indigenous fermentation of “umqombothi” is a more sustainable process of beer making that learners can be taught. (OS1)

We also capture teacher learning from our observation of the micro-teaching presentation using the observation schedule (OS) and teacher reflections in the POE.

Teacher Learning from IK Holder

Indigenous content related to the fermentation process of “umqombothi” and discussions on African festival rituals such as initiation school graduations, celebrations, communication with ancestors (Amadlozi). Umqombothi is vital for social and spiritual relationships. Invite ancestral spirits to participate in milestone activities. Connects spirits of the ancestors with those of the living. Labour intensive grain is crushed by women using “Idwala” which is another Isizulu word for “rock”. Women are involved entirely in the process and are respected as the authority in preparing umqombothi. Female gender has a key role in linking ancestral spirits to

present ones. This links the SDG 5: Gender equality whereby men are not the only gender to offer wisdom and spiritual guidance to the family. (POE1)

The connectedness of humans to the earth emanates from the use of the “grinding rock” to crush the naturally extracted ingredients. This connectedness is also shown through the use of sunlight as opposed to a stove or a fire for heat energy. Indigenous people use the sunlight to heat and ferment the mixture to produce *umqombothi* naturally, instead of using non-renewable fuels.

Teacher Learning from Self-Directed Research

We lean on Knowles, cited in Towle and Cottrell (1996), to describe teachers’ engagement in self-directed learning through research. Teachers took the initiative to plan their learning needs and learning strategies, to construct their learning goals, to determine the material and human resources they require to advance their learning and to evaluate the extent to which the learning outcomes were achieved.

In the portfolio of evidence, teachers’ reflections included the following:

We began research by conducting in-depth literature search about the fermentation in the making of “Sorghum beer” which was localised and relatable to what SA learners were familiar with. We referred to articles such as “Hlangwani, E., Adebisi, J. A., Doorsamy, W., & Adebo, O. A. 2020. Processing, characteristics and composition of umqombothi (a South African traditional beer). *Processes*, 8(11), 1451”. We watched many YouTube videos about SDGs and IK in beer production. (POE1)

The group also researched the Eastern European example “kefir” as an indigenous example of fermentation:

Kefir is an acidic-alcoholic fermented milk product with little acidic taste and creamy consistency that was originated in the Balkans, in Eastern Europe, and in the Caucasus. Kefir grains are added to goat or cow’s milk. Over approximately 24 hours, the microorganisms in the kefir grains multiply and ferment the sugars in the milk, turning it into kefir. The bacteria ferment the lactose in milk to lactic acid and provide the tangy flavour, while the yeasts ferment the available fermentable sugars in milk to yield small amounts of alcohol and CO₂, which gives kefir its fizz and effervescence. (POE1)

The two examples presented by Group 1 of *umqombothi* (African) and kefir (Eastern European) explore intercultural indigenous practices and corresponding science concepts.

Reconstruction of a Unit of Work

Knowledge of the Ancestors

During the micro-teaching activity, Group 1 used an indigenous, narrative pedagogical strategy, namely, storytelling. The following is taken from the observation schedule:

Storytelling pedagogy: The teachers in Group 1 were told a story by “Imbokodo” which they role-modelled during the micro-teaching presentation. The story began with the traditional significance of “umqombothi”. It features at Zulu and Xhosa weddings, funerals, rites of passage, and imbizos (traditional meetings). It’s also a customary part of making contact with the ancestors. In addition to the story of umqombothi, Imbokodo also indicated that umqombothi has a lower alcohol content than most commercially bottled beers. In traditional African culture, umqombothi is associated with respect for customs and traditions and not with intoxication. Drinking umqombothi from the gourd calabash which represents the cosmic womb. Inside it, the umqombothi directs intentions to “birth to life”, showing the strong links between African people and the cosmos. For example, drinking it at a Zulu wedding invites the positive intervention and sustainability of the marriage by the ancestors. The group further modelled the Ubuntu-ism shown by the consumption of umqombothi in a communal setting. The literal sharing of the traditional beverage between people sitting within a circle drinking from a single calabash emphasises the circle of life and the connectedness of human to human, human to nature and human to the cosmos. (OS1)

These various dimensions of connectedness represented by the indigenous culture and practices encourage relationships between people and also between people and the natural world.



Figure 2: African calabash; **Figure 3:** The Cosmic Womb (Source: POE1)

Below are two examples of African-centric curriculum materials presented by Group 1 during micro-teaching.

Example One: Curriculum Content about Alcoholic Fermentation from Africa

The role of anaerobic respiration, e.g., making of umqombothi. On the topic of Cellular Respiration, the fermentation of sorghum beer can be used as an example to enable learners to develop a deeper understanding of the concept. Sorghum beer (umqombothi) is an alcoholic beverage obtained from the fermentation of sugars, mainly those obtained from barley malt. This example from African culture can be taught to learners.



Step one: Mix half the malt with the maize meal in a bowl. Place the bowl in direct sunlight and add 2 litres of water and stir until you have a smooth paste.

What is in the malt? Why is this important?

Why is sunlight important?



Step two: Set aside in the sun, cover with a lid and leave in a warm place overnight to begin fermenting. Pour 4 litres of water into a large pot. Work in the soured mixture, stirring constantly.



Step three: Add 6 litres of cold water, mix in the remaining King Korn Mtombo and brown sugar. Cover with a lid and set aside for between 2 and 3 days to ferment. On the third day the fermented mixture will have a pungent smell and tiny bubbles will appear on the surface.

What type of fermentation has occurred? What type of gas is present in the bubbles? Write a word equation to show the reaction

Pour the beer into a large fine-mesh sieve. Using your hand or a large wooden spoon, press the beer mixture through the sieve to achieve a smooth liquid. At this point the teacher can discuss cellular respiration through the fermentation process. Evidence from the pungent smell and tiny bubbles in the "Umqombothi", indicate the release of gases (POE1).

Activity: Curriculum Content inclusive of African and Euro-Western Science

The "Law of the Conservation of Energy": Fermentation. The law states that "the number of atoms in the reactants is equal to the number of atoms in the products" from Oxford Successful Life Sciences Grade 11 textbook (Bezuidenhout, Clark, Doubell, Engelbrecht, & Cloete 2012, 102).

Word equation for fermentation:



Learners are required to:

- Identify the reactants and the products in the above word equation.
- Write out the chemical equation for Alcoholic Fermentation.
- Balance the chemical equation for Alcoholic Fermentation.

Figure 4: Making *umqombothi* and associated learner activity (POE1)

At this Point of the Presentation Group 1 Focused on SDGS which Are Linked to Alcohol Production from Fermentation

Achieving SDGs

Group 1 recorded the following in their POE:

The production of “umqombothi” is more environmentally friendly compared to the industrial process of western beer/wine-making. The indigenous ways of creating the sorghum beer by asking local indigenous people to make and sell it contributes to addressing poverty in the local communities. This addresses SDG 1: No poverty. The selling of “umqombothi” and “kefir” becomes a source of income which indigenous people can use to provide for their families. SDG 15: Life on land was also addressed. Indigenous people place the ingredients to make umqombothi in the sun (Figure 4), the heat energy accelerates the rate of reaction and fermentation. Heating ingredients using the sun as opposed to using industrial convection ovens or kettles in beer/wine-making means there will be less carbon emissions harming the planet. Traditionally, kefir grains were cultivated and extracted sustainably, by not overharvesting. Sorghum and maize, used in the production of umqombothi were traditionally grown using sustainable indigenous methods, including crop rotation and intercropping. (POE1)

The second activity proposed by Group 1 focused on SDGs and IK.

2.2 Read the information below and answer the questions that follow.

Traditional African Beer

Traditional beer forms a very important part of African culture. It is called *umqombothi* in isiXhosa and *iJuba* in isiZulu. The beer is mostly brewed from indigenous sorghum. The thick creamy African beer is very rich in vitamin B, it has a low alcohol content of less than 3% and it is inexpensive. The recipe for brewing beer is passed down through the generations.

The traditional method of testing to see if the brew is ready is to light a match close to the container of beer. If the flame dies quickly, the brew is ready. If the flames remain lit, the brew is not ready.

- 2.2.1 Name the biochemical process used to brew this African beer. (1)
- 2.2.2 What causes the flame to die? (1)
- 2.2.3 Why would this test be an indication of whether the brew is ready or not? (2)

A survey was done to determine the amount of people who drink industrially produced beer and traditional beer. The results for 1970 and then 1996 were as follows:

| Type of beer | Percentage of beer consumed | |
|----------------------------|-----------------------------|------|
| | 1970 | 1996 |
| Traditional beer | 90% | 30% |
| Industrially produced beer | 10% | 70% |

- 2.2.4 Plot a bar graph to show the results of the survey. (6)
- 2.2.5 Describe the trend shown by the graph. (2)
- (12)

Figure 5: Science about cellular respiration using an example from Africa (POE1)

The two examples used in reconstructing the unit included the development of scientific competencies such as biochemical processes and data presentations (graphs). Activities were designed to deepen understanding of sustainable development, Euro-Western practices and science, and IK.

Next, we present data from observations of the micro-teaching session and the POE compiled by Group 2.

Part C

GROUP 2: Example from the Natural Sciences Curriculum**Table 2:** Summary of presentation: Group 2

| Grade and Unit of Work | IK Content | Indigenous Pedagogy | SDGs |
|--------------------------------|--|---|---|
| Grade 6: Inorganic Fertilisers | Indigenous agricultural techniques: Soil nutrient retention; The use of chicken waste; The use of cattle dung. | Group work; Debates linked to Indigenous historical communities. | SDG 6: Clean water and sanitation; SDG 15: Life on land. |

Deconstruction of a Unit of Work in the Curriculum

Group 2 critically analysed the Natural Sciences unit of work “Water Pollution and Inorganic Fertilisers” in the CAPS document.

| GRADE 6 TERM 2 | | | |
|---|--|--|--|
| STRANDS: NATURAL SCIENCES: MATTER & MATERIALS TECHNOLOGY: PROCESSING | | | Equipment and Resources |
| Topic | Content & Concepts | Suggested Activities: Investigations, practical work, and demonstrations | |
| Mixtures and water resources | Water pollution <ul style="list-style-type: none"> • in the environment, many things mix or dissolve in water • water can be polluted by <ul style="list-style-type: none"> - insoluble substances, such as oil, plastics, tyres, tins, glass, toilet waste - soluble substances such as soaps, fertilizers, insecticides, acids and other poisons | | <ul style="list-style-type: none"> • Texts for reading about water pollution • Video clips from the internet |

Figure 6: Extract from Natural Sciences CAPS document on Water Pollution (DBE 2011, 55)

The group indicated that many synthetic fertilisers, soaps, chemical insecticides and other poisons are products of Euro-Western chemistry and are harmful to the lithosphere, hydrosphere and atmosphere.

Group 2 then engaged in critical analysis of textbook materials. Essy, Sbu, Thobisa and their chosen IK holder, Amandla, examined the *Oxford Natural Sciences Grade 6* textbook that is prescribed to teachers to inform the unit of work on fertilisers. Figure 7 captures an extract from the textbook, and is followed by the group's critique thereof, which was included in POE2.



All fertilizers have three numbers on the label, which indicate the fertilizer analysis, or "percentage by weight" of **nitrogen, phosphate (P_2O_5) and potash (K_2O)**, always in that order. In the picture to the left, the bag of lawn fertilizer has 25% nitrogen (N), 5% phosphate, and 5% potash. P is the symbol for the element phosphorous, and K is the symbol for the element potassium, and O is the symbol for the element oxygen.

Figure 7: Extract from *Oxford Natural Sciences Grade 6* textbook on fertilisers (POE2)

Artificial chemical fertilizers contain hazardous chemicals in addition to NPK which include, zinc, lead, cadmium, chromium and even arsenic. These chemicals may result in harmful effects to animal, human and environmental health. The use of these fertilizers contributes to unsustainable [practices], and these have come from colonial agricultural practice. Indigenous agriculture offers sustainable ideas about different products and methods to enhance soil nutrient content and retention. (POE2)

We capture teacher learning from our observation of the presentation by Group 2, using the observation schedule (OS) and teacher reflections in the POE.

Teacher Learning from Self-Directed Research

The following was captured from POE2 and indicates the source and content of teacher knowledge about natural fertilisers used by indigenous people:

Chicken manure adds organic matter and increases the water holding capacity and beneficial biota in soil. Chicken manure provides more Nitrogen, Phosphorus and Potassium to plants compared to horse or cattle manure (Chen & Jiang, 2014).

Cattle manure, or cattle dung, is used in farming as a popular practice in many rural areas. This type of manure is rich in nitrogen. Composted cattle manure can provide numerous soil benefits. Cattle dung can be reused as soil amendment to serve as slow-release P fertilizer (Chen, Qin, Sun, Cheng, & She, 2018).

Chen et al. (2018) note that soil which is made nutrient-dense using natural fertilizers contains the primary plant nutrients, namely, nitrogen, phosphorus and potassium along with a host of minor nutrients that promote plant growth. (POE2)

The group also explored the use of cow dung through Indian, Ayurvedic knowledge:

Cattle dung in India is also used as a co-product in agriculture, such as manure, biofertiliser, biopesticides, pest-repellent (through the smoke from burnt dry cattle dung), as a source of energy and for sanctifying the soil. According to Ayurveda, it can also act as a purifier for all the wastes in nature. According to Ayurveda, Gomeya/cattle dung is not a waste product, but it is a purifier of all wastes in nature. When spread over urban and rural waste in solution form, it biodegrades the waste in time. [Source: Gupta, K. K., Aneja, K. R., & Rana, D. (2016). Current status of cattle dung as a bioresource for sustainable development, *Bioresources and Bioprocessing*, 3(1), 1-11]. (POE2)

Teacher Learning from IK Holder

Group 2 indicated that they had learnt about the usefulness and potential harm (when used in incorrect concentrations) of natural fertilisers from Amandla. They were advised to use indigenous ways of teaching, such as debating. The IK holder had explained to Group 2 that debating was used for centuries by African indigenous communities at counsel and village meetings to solve disputes and test a person's intellect. The following is taken from the observation schedule:

Long before Africa was colonised, African societies used the institutional mechanism of “public debating” as a cultural tool to uphold the values of peace, tolerance, solidarity and respect for one another, i.e. Ubuntu. Amandla proposed that learners engage in debates about the usefulness and potential harm that can result from the use of artificial fertilizers, produced as a result of Euro-Western chemistry, and natural fertilizers commonly used by indigenous people. (OS2)

Reconstruction of the Unit of Work from the Curriculum

Two examples to revise the unit of work were developed by Group 2.

Knowledge of the Ancestors

Example One: Curriculum Content about Natural Fertilisers

Members of Group 2 researched the fertilisers used by indigenous people. These serve the same purpose of enriching the soil, which was represented by Euro-Western examples of inorganic fertilisers in prescribed textbooks.

At learners' households, parents only practice subsistence farming which depends on natural fertilizers because chemical fertilizer are expensive for them. There is common practice done in most villages, in a Rondavel (African Hut often used as kitchen and where chickens sleep), every morning indigenous people sweep chicken waste and throw the waste into the garden. Discussions of the significance of a Rondavel and chicken waste as fertilizers could be explained to learners.

Figure 8: Chicken waste as natural fertiliser (POE2)



Another traditional practice that could be used when teaching fertilizer is the use of cattle dung when planting to enrich soil with nutrients. Indigenous people remove dried cattle dung from the kraal and mix seeds like maize with it. They add other biodegradable waste materials to the dung mixture, which is added to the soil as fertilizer.

Figure 9: Cattle dung as a form of indigenous fertiliser (POE2)

The group identified that the inclusion of the above examples within the unit of work on inorganic fertilisers from the Natural Sciences Grade 6 curriculum could address various SDGs. The “chicken waste” and “cattle manure” for enhancing soil fertility were examples from IK. The IK holder verified the accuracy of the indigenous practice related to these natural forms of fertiliser. After this verification, the information was included in the POE and the micro-teaching presentation.

Group 2 discussed the following SDGs that were associated with this unit of work.

Achieving SDGs

The group planned to teach the SDGs by tapping into IK about fertilisers. The group addressed SDG 6 (Water and Sanitation) and SDG 15 (Life on Land). Their portfolios of evidence noted the following:

SDG 6 was addressed whereby Euro-Western fertilizers were explained to cause poor biological condition to water resources. Lakes and rivers become “hypereutrophic” (meaning that high levels of nutrients and algae are degrading water quality). High levels of “nutrients”, such as phosphorus and nitrogen (both components of synthetic fertilizer) threaten the health and biological diversity of waterways, which can result in loss of aquatic life and their habitats, shellfish contamination and seasonal dead zones. They also cause algal blooms which harm aquatic. Excessive nutrient runoff in waterways can impact drinking water supplies and cause severe health problems.

CAUTION: using Natural fertilisers recommended by IK holder—the use/disposal of chicken and cattle waste should be done in a sustainable manner and not be allowed to enter water sources through soil run off. The high ammonia content in chicken and cattle waste is harmful to aquatic creatures. When ammonia is present in water at high levels, it is difficult for aquatic organisms to sufficiently excrete the toxicant, leading to toxic build-up in internal tissues and blood, and death. Environmental factors, such as pH and temperature, can affect ammonia toxicity to aquatic animals (Chen et al., 2018). (POE2)

This kind of approach whereby SDG 6 can be addressed in the context of both indigenous and Euro-Western knowledge marks a decentring of Western knowledge and the production of that “third space” (Le Grange 2016, 10) in which different knowledges can function together to create an accountable curriculum (according to Mudaly 2018). As noted in their portfolios of evidence, there were

[l]inks to SDG 15, the protection of Life on land by using organic fertilizers. Organic fertilizers, when used correctly, cause less damage to the environment than inorganic fertilizers. Inorganic fertilizers are toxic to soil organisms, they poison the soil organisms and enter and are passed along the food chain causing harm to all feeders, thereby threatening life on land. Organic fertilizers when applied correctly using the indigenous methods enhance soil nutrient retention. Manufacture, storage and transport costs of inorganic fertilizers surpass that of organic fertilizers. (Chen & Jiang, 2014). (POE2)

Example Two: Practical Activity to Develop Skills Related to Improving Soil Nutrient Content Using IK

The micro-teaching session, where Essy presented details of how Group 2 developed and implemented a practical activity based on different forms of soil nutrient retention techniques, was observed and recorded as follows:

Essy and Amandla had transported learners to Amandla's domestic garden. Amandla demonstrated to the learners the preparation techniques for traditional fertilisers for her garden using cattle dung and chicken waste. Learners engaged in hands-on activities, by following Amandla's instructions related to the soil turning technique, whereby only the soil needed for planting was turned using garden forks and spades. Essy explained to learners that these techniques are different from industrial techniques, where large plots of land are turned using industrial machines which give off high yields of carbon-dioxide and disrupt subterranean biomes. Learners were given an opportunity to mix in the animal waste with other biodegradable materials like vegetable peelings and prepare beds for planting. (OS2)

Part D: Deeper Analysis and Discussion

Based on the data we distil the following key moves in our quest to cross abyssal lines of thought.

Consciousness Raising

We engaged teachers in professional development activities that were driven by a decolonial intent. This created spaces for deep teacher reflection on the ideology that underpins the curriculum. Teachers lamented the effects of colonisation on present-day education. Their consciousness about dispossession of land, religion, status, and the denial of their potential to think independently was revealed during the interviews (Part A). The plundering of the resources, identity, intellect and souls of people was mourned (Chilisa 2012). Teachers talked about hopelessness, fear, and violence that colonisers brought to Africa. They alluded to the valourising of scientists from the North as "God(s) of science". They understood their subaltern status fully, and were aware that scientists from the North are positioned as barometers and moderators of true, valid knowledge, making it necessary that "whatever that we do we have to pass by them". Teachers understood the intellectual authority (Connell 2007; De Sousa Santos 2007; Mignolo 2011) that is attributed to knowledge producers from the North. But they also expressed the need to disrupt this knowledge hierarchy.

Decentring Euro-Western Knowledge

A critical analysis of school curriculum documents and textbooks revealed to the teacher participants the dominance of Euro-Western frameworks. Their analysis revealed that the curriculum content knowledge, as well as pedagogic strategies, resonated with people from the global North. The curriculum favoured contexts of knowledge production as well as knowledge producers from the global North. The assertion by Christie and McKinney that "coloniality survives colonialism, it is maintained alive in books" (2017, 243), was among the findings made by the teachers.

Decentring Euro-Western knowledge was a challenge to teachers who had been schooled only in Euro-Western science. They collaborated with IK holders in order to dream (Chilisa 2012) about possibilities for culturally inclusive curricula. By drawing

on insights from the IK holders, Imbokodo and Amandla, teachers expanded their epistemic horizons (Takayama 2016). Southern voices were brought to the fore in the production of useful knowledge (Barreto 2014).

Recentring Knowledges from the South

Teachers were committed to engage in intercultural dialogue in order to build their capacity to transcend epistemological boundaries and to create more epistemically diverse curricula (Padayachee, Matimolane, and Ganas 2018). They learnt about Southern ways of being, or, as Maldonado-Torres (2011) states, the decoloniality of being, using the example of consuming *umqombothi* from a single calabash, which represents the “cosmic womb” (POE1). This “emphasises the circle of life and the connectedness of human to human, human to nature and human to the cosmos” (OS1) and allows for re-aligning ontological positioning. The valuing of social and spiritual relationships, the linking of ancestral spirits to the living, represents a distinctly Southern way of being, and contributed to teacher capacity to *do* science thinking and teaching differently. Teacher capacity development was made possible by teachers’ commitment to act by engaging in self-directed research. Teachers were able to incorporate ideas from India, Africa and Eastern Europe to teach about fermentation and soil fertility. They learnt about storytelling as a useful way to facilitate knowledge construction. They utilised debating as a learner-centred approach based on their understanding of its value within indigenous African societies. The myth that IK is passed passively, without questioning, from generation to generation, was debunked.

Teachers engaged learners in hands-on activities as they reclaimed IK into the mainstream CAPS curriculum. During the field trip to Amandla’s home, real life materials, such as soil and fertiliser, were handled by learners in concrete ways. The skills of following instructions, preparing soil and protecting soil and its organisms when creating beds for planting were learned through direct experience. Learners were literally connected to the earth, and this conscious link to the human and non-human was strengthened. Learners worked in groups to prepare beds for planting. The individual “I” was not favoured in this setting. Instead, the oneness of the self was united with other humans and the non- human world, and the more-than-human world was valued (Le Grange 2014).

Crossing the Abyssal Lines of Thinking

The move away from Eurocentric, “Whitestream classrooms” (Desmarchelier 2020, 642) represented a decentring and not an abandonment of this ubiquitous canon. Instead, teachers worked towards “flattening hierarchies ... where one knowledge system is not viewed as superior (Western) and another (namely, indigenous) as inferior” (Le Grange 2014, 1280). It can be argued that our focus on SDGs (paradoxically) favours what Singh (2020) refers to as the more affluent, technologically advanced and better resourced global North. However, the 2030 Agenda for Sustainable Development has been embraced globally, regardless of

geopolitical positioning. Therefore, adopting SDGs as a curriculum focus was suitable to explore possibilities for what De Sousa Santos (2007) refers to as post-abyssal thinking. Teachers journeyed into intellectual territories that are external to those of the West (Takayama 2016). They became more familiar with this “new” intellectual world by engaging in intercultural dialogue (Barreto 2014), and self-directed research, to learn about a plurality of knowledges (Mudaly 2018). Teachers identified different traditional practices that had a common biochemistry, such as fermentation. They assured the quality of the revised curriculum unit by engaging the IK holder to review it. In this way, they restored the identity of the IK holder as a barometer of valuable knowledge.

Concluding Remarks

Teachers’ access to conceptual and theoretical tools through the professional development programme created the space for them to think deeply about the effects of colonisation on present-day society and its people. In working towards a decolonial epistemic politic, we examined how teachers in this study displayed the mourning, dreaming and action espoused by Chilisa (2012). Teachers mourned the culturicide, epistemicide and several forms of dispossession, which have left their mark long after the colonial flags were lowered. They engaged in intercultural dialogue and self-learning to dream about possibilities for creating relevant units of work that could restore the African identity. By restoring the IK holder as a teacher whose knowledge is worthwhile, teachers and their learners were able to rediscover and recover their culture (Chilisa cited in Le Grange 2016, 3), and reimagine an alternative curriculum that recentres IK and knowledge for SD. The hermeneutical act of “subverting totality is not only one of retrieval but also one that is historically located and re-imaginative [linked to dreaming], allowing multidirectional innovative exchanges” (Omer 2020, 287). Le Grange (2016) explains that action, espoused by Chilisa (2012), is the phase where dreams and commitments translate into strategies for social transformation. In the context of this study, the action allowed for the transformation of ontological positioning by renewing the interconnectedness of the human with the earth, cosmos, plants, animals and spirits. Different types and sources of knowledge, within their sociocultural contexts, were foregrounded, and resulted in epistemological diversity. These knowledges were connected creatively to facilitate the learning of science. The methodology was transformed because it privileged linking learners with IK holders who were positioned as repositories of useful knowledge. These decolonial teacher moves allowed for a repainting of the curriculum canvass and recasting the curriculum actors to participate democratically in a more-than-human world.

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