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Integration of Indigenous Knowledge in Namibia's Grade 8 Physical Science Curriculum: A Case Study on Physical and Chemical Changes

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ABSTRACT: This paper reports on findings from a qualitative case study that examined the integration of Indigenous Knowledge (IK) in Namibia's Grade 8 physical science curriculum, focusing specifically on the topic of chemical and physical changes. The importance of this study lies in the emerging knowledge that is helpful in the incorporation of IK. The integration of IK enriches science education by making it more relevant and accessible, fostering a deeper connection between learners' cultural experiences and scientific knowledge. The research aimed to discover what lessons Grade 8 physical science teachers can learn about physical changes, chemical changes, and IK integration through co-analyzing curriculum documents. Qualitative data were generated through document analysis, including the Namibian National Curriculum for Basic Education, the Grade 8 Physical Science syllabus, the National Subject Policy Guide, and two learners' textbooks. To analyze these documents, we used the Cultural Discontinuity (CD) framework and the Border Crossing Framework. The findings revealed that the curriculum statement supports and requires science teachers to integrate IK to contextualize scientific concepts. However, explicit guidance and examples are sparse. On the other hand, the textbook analysis revealed that the recommended textbook lacks examples that are relevant to IK integration. Conversely, learners' textbooks authored by Namibians seem to contain rich examples of chemical and physical changes relevant to the learners' lived experiences. The findings underscore the need to consider local context and IK when selecting educational resources to ensure effective learning. The study recommends revising the NCBE curriculum to include explicit guidelines for integrating IK.

Keywords: physical science, physical and chemical changes, indigenous knowledge, topic-specific pedagogical content knowledge

Introduction

Teaching and learning in context can significantly influence learners' academic experiences and achievements, either positively or negatively. When the context is relevant and familiar, learners are

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more engaged, motivated, and able to apply their knowledge effectively, leading to better academic outcomes. Conversely, if the context is unfamiliar or irrelevant, it can create cognitive dissonance (Aikenhead et al., 1996; Mavuru et al., 2017), hinder comprehension, and reduce motivation, ultimately impacting academic performance negatively. That is, learners struggle to reconcile school material with their home and community experiences. To address this issue, some scholars advocate for integrating Indigenous Knowledge (IK) into the science curriculum to provide a relevant context for learning science (Jones & Hunter, 2003). Before, there was no suggestion on how IK can be integrated. Integrating real-life contexts into education has the potential to provide opportunities for contextualization, making science more relevant and accessible to learners. Against this background, this study aimed to discover what lessons Grade 8 physical science teachers can learn about physical changes, chemical changes, and IK integration through co-analyzing curriculum documents. The following research question was addressed:

- What lessons can Grade 8 physical science teachers learn (or not) about chemical and physical changes integrated with IK through co-analyzing the curriculum documents?

Background and Context

Contextual teaching and learning (CTL) is an educational approach that emphasizes the importance of relating academic content to real-world situations and learners' personal experiences (Afni, 2020; Glynn & Koballa, 2005). Contextual learning refers to educational practices that incorporate the cultural, environmental, and social contexts of learners into the curriculum. For Indigenous learners, this approach is crucial as it connects the educational content with their lived experiences (Gwekwerere, 2016), cultural practices, languages, and traditional knowledge systems. Indigenous Knowledge (IK) serves as learners' *prior* knowledge, which they bring into science lessons.

In the context of this study, prior knowledge is not limited to earlier exposure to curricular content (Hailikari et al., 2008) nor to formal learning (Mei Tan & Laswad, 2008). However, it should encompass all unstructured learners' life lesson experiences learned through their interaction in the home or community environments (Inkelas, et al., 2023). This stance thus encourages the integration of Indigenous Knowledge practices in the school curriculum, specifically as teaching and learning materials. The approach also helps learners understand how the material they are learning is relevant to their lives outside the classroom.

Hence, the Namibian curriculum recognizes the potential context of context in shaping learners' academic outcomes and thus calls on teachers to integrate learners' prior knowledge and everyday experiences (Namibia Ministry of Education, Arts and Culture [Namibia MEAC], 2016). However, the curriculum implicitly encourages integrating Indigenous Knowledge (IK) through phrases like 'existing knowledge' and 'everyday experiences. Since explicit guidance for IK integration in science lessons is lacking, there seem to be varied interpretations among teachers. Notably, this study convenes Grade 8 physical science teachers to examine curriculum documents and assess the extent to which Indigenous Knowledge (IK) is integrated into the topic of chemical and physical changes.

Studies conducted in Namibia by Asheela (2017) and Simasiku (2017) revealed that teachers seem to lack awareness of IK integration. Literature shows that only teachers who have been 'trained', understand and use IK in their science lessons (Ogunniyi, 2007a). However, enriching curriculum materials like learners' textbooks and teachers' guides plays a pivotal role in integrating IK into science teaching. By integrating IK perspectives, these curriculum materials would make science education more inclusive, culturally relevant, and engaging.

The first author in his teaching experience has been grappling with learners' lack of understanding of chemical and physical changes. The challenge has negatively impacted the learners' performance in Senior Secondary Chemistry. The assumption is that the concepts of chemical and physical changes might be presented in inaccessible contexts and this resonates well with Wong (1998), Tramonte and Willms (2010) who assert that, the absence of cultural perspectives in school curriculum content, makes comprehension of school curriculum difficult to understandable for learners. Given this context, the study aimed to illuminate the visibility or absence of Indigenous Knowledge integration in teachers' and learners' materials in Namibian schools through a collaborative analysis of curriculum documents with science teachers.

Literature Review

Indigenous Knowledge Perspectives and School Science

Indigenous Knowledge System (IKS) scholars have offered different definitions of Indigenous Knowledge (IK). For instance, there is a general consensus that IK includes the insights, skills, and philosophies developed by societies with deep-rooted connections to their natural environments Mavuru & Ramnarain, 2017). To Nakitare et al. (2024), IK is a body of information passed down through generations in a given locality, acquired through experiences, relationships with the surrounding environment, and traditional community rituals, practices, and institutions. Integrating this knowledge into formal education system, particularly in science curricula, has the potential to enhance the relevance and contextual appropriateness of education. Concerns from IK scholars (e.g., Mukwambo et al., 2014; Shizha, 2013; Wangola, 2002) are that Eurocentric epistemologies have been accorded a superior status over the Indigenous Knowledge System (IKS) in most African school curricula. The consequences of embracing Westernised school science curricula, Indigenous learners are subjected to learning school science in unfamiliar contexts and thus, experience some form of disconnection from school curricula content.

Yet, a sense of belonging at school is a crucial element of the broader concept of learner engagement, and is linked to various educational outcomes, including academic achievement (Finn & Rock, 1997). Moreover, when the education system fails to integrate IK, Indigenous learners are alienated, undervalued, leading to disengagement from the learning process and ultimately leading to failure. This resonates with, Winzer and Mazurek (1998), who contend that learners' conceptual frameworks, their ways of learning and thinking are deeply rooted in their own cultures or Indigenous ways of knowing. Difficulties in classroom learning and interactions occur when there is a discontinuity or mismatch between a learner's culture, along with its intricate elements, and the culture of the teacher and the classroom. This mismatch can potentially set the learner up for failure if the school curriculum is not attuned to his or her specific needs (Vos, 2014).

Lipka (2002), a researcher at the University of Alaska, Fairbanks, conducted extensive studies on the impact of integrating Yup'ik culture and language into core subjects like science, mathematics, and literacy in rural schools in western Alaska. The findings attested to the power of culturally relevant curricula and teaching practices in enhancing Native learners' learning outcomes. IK integration in the school curriculum is aimed at restoring continuity between the learners' home cultures of Indigenous knowledge practices. Hence, IK integration needs to be made visible in the schooling system, including teaching and learning resources.

Curriculum developers particularly in Africa, are called to align the curriculum and classroom processes with learners' socio-cultural backgrounds (Mavuru & Ramnarain, 2020) and perspectives for higher academic success for the Indigenous learners whose home cultures differ from the schools. In this regard, looking at best practices from other regions can provide valuable insights for integrating IK into the Namibian science curriculum. For instance, New Zealand's Māori knowledge has been integrated into science education and has been successful in enhancing student engagement and achievement (Wood & Lewthwaite, 2008).

Context Learning and Science Education for Indigenous Learners

Context learning recognizes that education is not a one-size-fits-all process and emphasizes the need to make learning relevant and meaningful to learners' worldviews and community values (Ganesan et al., 2024). Context learning offer avenues facilitating border-crossing issues in the learning environment (Aikenhead & Jegede, 1999). Rothstein (2004) observed that efforts to close the educational achievement gap between Black and White learners in the United States are likely to fail due to an exclusive focus on school policies and practices while seemingly ignoring the influence of social class. It seems that the hegemonies and cultural reproduction of Westernized school science delineate (Carlone et al., 2015), marginalize and make it difficult for learners to make sense of abstract science concepts (Govender, 2016). Commenting on contextualized teaching and learning pedagogical practices (CTLPP), Mukwambo (2016) says it can make science and math concepts more meaningful and relevant to students and teachers can do this by incorporating real-world examples and scenarios, to help learners understand the practical applications and value of the subject matter.

Apparently, integrating Indigenous Knowledge (IK) and practices could provide the much-needed context for learning school science. However, efforts to integrate IK perspectives are often superficial and lack significant depth and breadth. In Namibia, for instance, the National Curriculum for Basic Education (Namibia MEAC, 2016) only superficially mentions IK integration. This highlights the necessity for more comprehensive strategies that fully incorporate Indigenous knowledge and perspectives into the curriculum, along with the necessary resources and teacher training. To this effect, science learning materials, such as textbooks, need to be culturally appropriate and relevant, and it seems crucial that they be developed in collaboration with Indigenous communities, educators, and knowledge keepers (McKinley, 2013; Arcinas, 2025). This collaboration can help create resources that are not only scientifically accurate but also aligned with Indigenous values and ways of knowing (Zidny et al., 2020). From this discussion, it appears that while there is a growing recognition of the importance of contextualized learning and IK integration, there remains a gap between policy intentions and actual implementation. Many efforts seem to lack the depth required to bring about meaningful curriculum transformation. This raises concerns about whether such superficial approaches truly address the challenges learners face in engaging with science education. Therefore, a more intentional and systemic effort is necessary to bridge the disconnect between Indigenous perspectives and formal science education, ensuring that knowledge integration is substantive rather than merely symbolic.

Indigenous Perspectives on Physical and Chemical Changes

Indigenous communities in Namibia have long observed and utilized physical changes in their daily lives. For instance, the Himba people use the process of drying and fermenting wild plants to preserve food. This traditional practice involves understanding the physical changes that occur during dehydration and the role of temperature and humidity in the preservation process. Traditional Himba practices, such as the use of ochre to protect their skin from the sun and the preservation of meat through drying and smoking, involve understanding physical and chemical changes. Incorporating these practices into science textbooks can provide learners with concrete examples of scientific concepts and highlight the relevance of IK. Chemical changes are also evident in many Indigenous practices in Namibian cultures. The San people, for example, have used the process of fermentation to produce alcoholic beverages from natural resources. This involves an understanding of the biochemical processes that occur during fermentation, including the role of microorganisms and the conversion of sugars into alcohol and carbon dioxide. Teaching these processes in conjunction with conventional chemical reactions can offer learners a broader perspective on chemical changes and their relevance to everyday life. This approach not only enhances learners' scientific knowledge but also fosters an appreciation for the cultural significance of these practices.

Theoretical Framework

This study is grounded in the Cultural Discontinuity (CD) framework and Aikenhead's (1996) Border Crossing Framework. The Cultural Discontinuity framework, which was advanced by sociocultural theorists such as Wertsch (1991) and Winzer & Mazurek (1998), examined how learners' culturally-based learning preferences and practices, typically shaped through home and community socialization, are often disregarded or disrupted within formal schooling (Tyler et al., 2008). Terms like cultural mismatch, misalignment, or dissonance similarly describe this phenomenon, where a disconnect exists between learners' cultural identities and school environments. The CD framework posits that these cultural discontinuities can hinder learners' engagement, understanding, and academic success. Specifically, differences between the cultural values, communication styles, and knowledge systems of learners' home environments and those promoted in schools may result in disengagement, behavioral challenges, and underachievement (Kanu, 2007). In this study, the CD framework is applied to explore how Indigenous Knowledge (IK) is woven into, or marginalized within, the Namibian science curriculum. It guided the investigation by identifying gaps in IK integration, analyzing teacher practices regarding IK integration, and critically reviewing curriculum documents. The cultural discontinuity hypothesis emphasizes the need for educational systems to be more inclusive and responsive to the cultural backgrounds of all learners, fostering a learning environment where diverse cultural practices and perspectives are recognized and valued. On the other hand, Aikenhead's (1996) Border Crossing Framework provided a valuable lens for analyzing the inclusion and treatment of Indigenous Knowledge (IK) within Namibia's science curriculum. This framework addresses how learners from non-Western cultural backgrounds navigate the often-rigid boundaries between their everyday cultural knowledge systems and the predominantly Western epistemology of school science (see **Figure 1**). Aikenhead conceptualizes learning science as a process of cultural border crossing, where learners engage in moving between the familiar knowledge and practices of their home or IK. **Figure 1** summarizes the framework's four types of border-crossing learners' experiences. Applying Aikenhead's framework to this curriculum document analysis study allowed a critical examination of how the science curriculum facilitates, manages, or obstructs these border crossings. Specifically, the framework guided the analysis to explore:

- Whether Indigenous knowledge is authentically integrated into the science curriculum or merely mentioned superficially.
- The extent to which the curriculum acknowledges and values Indigenous worldviews alongside Western science.

- The presence or absence of supportive mechanisms that assist learners in navigating between knowledge systems.
- Finally, Aikenhead's border crossing framework offered a powerful analytical tool to assess the depth and effectiveness of IK integration in Namibia's science curriculum documents analyzed.

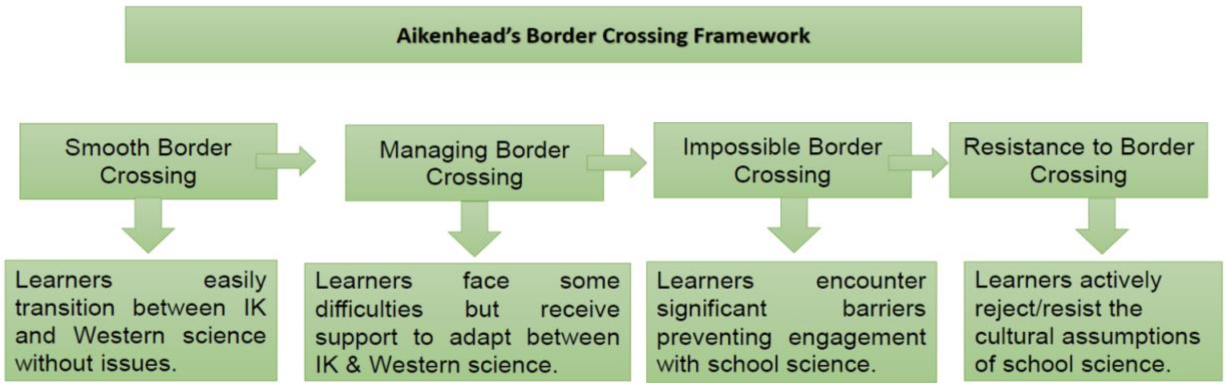

Figure 1. Aikenhead's (1996) border crossing framework (Source: Aikenhead's (1996), pp. 14-17)

Methodology

According to Wohlin and Runeson (2021), methodology in research entails the means to generate and analyze data. The methodology describes how the researcher planned to carry out a research study. This includes the research paradigm, design, sampling of participants, data-generating techniques, and the process for data collection and analysis, as well as ethical considerations.

Research Paradigm

A research paradigm is understood as a lens through which a researcher differentiates worldviews (Creswell, 2016). The interpretive paradigm was employed as the researchers' lens in the study. According to Cohen et al. (2018), interpretive research studies seek to provide a rich description of the phenomenon under study, as well as provide the answer to the research question. The interpretive paradigm resonates well with the two theories employed in this study, the cultural discontinuity framework (Winzer & Mazurek, 1998) and Aikenhead's (1996) Border Crossing Framework, both support integrating IK into school science learning as a mean of providing indigenous learners with a familiar context for learning science. It is also a sign of respect for the differences between Western and indigenous epistemologies, ontologies, and axiologies (Chilisa 2012).

Research Design

According to Bertram and Christiansen (2020), a research design is a disposition showing how the researcher plan to systematically collect and analyse the data needed to answer the research questions. This study adopted a qualitative case study research design. To Cohen et al. (2018), a case study is a detailed phenomenon under close consideration. The case in this study aimed to discover what lessons Grade 8 Physical Science teachers can learn about physical changes, chemical changes, and integration of Indigenous Knowledge in grade 8 Physical science curriculum through co-analyzing the curriculum documents. A case study was deemed appropriate while seeking an in-depth understanding of how IK can be integrated.

Participants

A purposive sampling method of research participants was employed in this study (Cohen et al., 2018). The target participants were four grade 8 Physical Science teachers with more than five years' experience of teaching chemical and physical changes in teaching grade 8 Physical science classes. Four teachers were approached and served with invitation letters to voluntarily participate in this study. All four were male and three holders of a degree in education specializing in teaching science. The remaining one has a diploma in education specializing in teaching science. The sample size of four and a critical friend were deemed to be more than enough; for instance, if one or two teachers withdrew from the study, two participants would still allow me to generate enough quality data. Lastly, the participants were given codes to conceal their identities.

Data Generation Method

Due to the nature of the study that the first author was positioned as a co-learner as well as researcher. Participatory observations were employed first during the teacher workshop discussions on curriculum document analysis where the second researcher was also present. Discussions were videoed on camera, with consent obtained from the participants. Sometimes the main researcher collected the data alone but in other instances the other researcher was invited to help in the data generating and analysis. The second researcher was also involved in the second stage of document analysis and this made video recording easy. The third researcher was mainly responsible for checking and reading through what was compiled. According to Cohen et al. (2018) using video and audio recording devices to record is more accurate compared to taking notes. This allowed us to return to these recordings during our data analysis or at any other stage for validation purposes.

Data Analysis

Data analysis was achieved by looking for patterns in the data in the information generated and then relate it with concepts in the grade 8 curriculum. For instance, the cultural practices involving physical and chemical changes were analysed to see whether there are some ideas congruent with those in the official curriculum. This supports the idea of embracing constructivist theory of teaching and learning Vygotsky (1978) advocates as congruent constructivism as one of its strand sticks out

Ethical Considerations and Analysis

Ethics in research is concerned with acceptable behaviour considered right when conducting research (Bertram & Christiansen, 2020). In the case of this study, ethical approval to conduct this study was granted by Rhodes University's Research Ethical Committee; Review Reference: 2020-1151-3551, in the Faculty of Education through the Education Higher Degrees Committee. Furthermore, the Zambezi regional education director granted the first author permission to conduct the study in the region. Participating teachers were presented with request letters regarding this research and informed consent letters were signed, after the first author had explained to the participants of their voluntary roles. The participating teachers choose pseudonyms instead of their real names: Willie, Sipho, Mac, Marth and Mat. Qualitative data from the workshop discussion were deductively analysed, the mention of indigenous knowledge and the depth of integration (superficial, moderate, deep) in the analysed documents formed the unit of analysis.

Findings and Discussion

Findings from the Namibian National Curriculum for Basic Education

Teachers learning about the National Curriculum for Basic Education for the first time: Below is an extract from the participating teachers when responding to why they did not bring hard copies of NCBE:

> *"I do not have that document" (Willie).*
>
> *"Me too, I do not have it, I could have brought" (Marth).*
>
> *"I do not have it too; I tried asking some colleagues at school they do not know it too" (Mac).*
>
> *"Aah me I have heard of the document curriculum, but I have not seen it with my eyes or touched it" (Sipho).*

The teachers' responses clearly show that they were learning and seeing the National Curriculum for Basic Education for the first time. Harris and Reynolds (2018) point out that since teachers are the intermediaries who interpret and enact the intended curriculum, therefore, it is important to know how they use these official policies to guide teaching and learning in the schools. NCBE, determines the requirements with regards to integration of local or indigenous knowledge (IK) in science classrooms in Namibia. On page 1, *Marth* read loud in our hearing: *"The NCBE is the official policy for teaching, learning and assessment and gives direction to planning, organizing and implementing teaching and learning"* (Namibia MEAC, 2016, p. 1).

The NCBE, implicitly and superficially mention and encourage teachers to integrate IK. As can be seen in the extract; *Mac* invited everyone to page 5;

> *"Ah I found something here; section 2.1 the goal of basic education, on page 5. It reads; a knowledge-based society is characterized by the effective and wise use of <u>existing knowledge</u> and the creation of new knowledge… (Namibia MEAC, 2016. p.5).*

Unpacking the curriculum statement above we focused on the term existing knowledge and we learnt that this term referred to the effective use of local or indigenous knowledge as prior-knowledge (Hattan, et al., 2024). For instance, *Willie* reasoned; *"something that is existing, means it is not foreign"*. Adding to the discussion *Mat* highlighted that:

> *"If you look at most science concepts like blast furnace, catalyst, and stoichiometry or waves these concepts may be foreign, what the curriculum requires from us then, is to be wise in finding existing (indigenous) knowledge that can be associated to the concepts. For instance, before teaching about the blast furnace you may refers you learners to our simple "Mapukuta" traditional blast furnace used by indigenous blacksmith, since the learners are familiar with it they will easily understand the concept of blast furnace".*

Evidence of learning that was taking place can be observed in *Sipho*, who was left with no choice but confess his familiarity to *Mapukuta* and the blast furnace and said:

> *"I never thought of associating scientific concepts to local knowledge this way, I have personal used a Mapukuta and I have taught extraction of metals in grade 10, where the blast furnace*

is introduced, I never knew I could bring in a Mapukuta as a model" (Sipho).

The *Mat*'s illustrations resonate with Cepni, Ulger and Ormanci (2017) who advanced that science lessons need to be associated with daily life, that is, while discussing a science topics connection from the daily life be made. Teachers were thus, enlightened on how to associate or make reference of modern school science to learner's everyday life experiences in their science lessons. This ensures cultural continuity, proving familiar context for learning modern science.

Further, *Marth* also pointed us to a paragraph on page 5 where the term indigenous knowledge is used, referring to the type of knowledge that Namibian learners should acquire to realize Namibia's ambition of becoming a knowledge-based economy; "…*knowledge… encompass indigenous knowledge, local and national cultures, and international and global culture"* (Namibia MEAC, 2016, p. 5). This curriculum statement clearly calls these teachers to integrate local or IK in their classrooms. Unpacking this statement further, the teachers learnt that: the knowledge Namibian learners should be empowered with to make Namibia a knowledge-based society should include Indigenous or cultural knowledge of the local community, alongside international and global cultural knowledge.

Further discussions revealed that the contexts in the physical science subject are devoid of local context; knowledge content contexts are mainly international or global; there are no traces of local cultures. However, teachers deliberated and realized their roles to bring in science lessons relevant local context or cultural knowledge, beliefs and ways of life of the societies in which they teach. The Namibia. NCBE (2016, p.39) further revealed that: the community around the school could be an important source of knowledge, support and resource. Not, only financial resources in the form of donation, but teaching and learning resources.

The Namibia MEAC (2016. p.52) states that; *"in the community there may be <u>persons with expertise</u> in for instance language and <u>cultural traditions, crafts</u>, sport, health, entrepreneurship or agriculture, who may be <u>approached</u> to support teaching or co-curricular activities"* (my emphasis). The next discussion was on the physical science syllabus.

Findings from the National subject policy and Physical Science Syllabus

The focus of analysis both in the National subject policy and Physical Science syllabus were also on the mention of indigenous knowledge and the depth of integration. We also found these two documents do not clearly mention IK but uses other terms relevant to IK. For instance, *Sipho* had invited us to section 3.11 in the National subject policy on learner centered education. It read:

> *"Learner centered takes as its starting point the learners as an active, inquisitive human beings, striving to acquire knowledge and skills to master his or her surrounding world. Learners bring to school knowledge and social experiences from home, community and environment. This knowledge and experiences is potentially that it should be ultilised and drawn into teaching and learning" (Namibia MEAC (2008. p.7).*

This section encourages teachers to integrate the knowledge that learners bring to school knowledge and experiences from home, community and environment potentially to be used during teaching and learning. We identified these experiences learners bring to school to encompass Indigenous Knowledge (IK). Together with the teachers we unpacked the need to elicit and challenge the knowledge learners bring to school. Teachers learnt that, some of the beliefs may turn to be unscientific thus, challenging or allowing learners debate these cultural beliefs and experiences, lessens the misconceptions and confusions. Though, the teachers have not being given support, the discussion resulted in a shift in their ZPDs towards local or IK. This is evident in *Sipho*'s comment saying:

> *"Oh I see, in these curriculum documents instead of using this term indigenous knowledge*

they use terms like knowledge from home, prior knowledge, social experiences learners bring to school".

The analysis and discussion of the Physical science syllabus focused mainly on chemical and physical changes topic and the opportunities presented within the learning objectives to integrate local or IK. As it can be seen in **Table 1** an extract from the syllabus, (Namibia MEAC, 2016). The specific objectives listed as bullet points 4 and 6 in the **Table 1** explicitly highlight the opportunities for integrating Indigenous Knowledge (IK). Even though, IK remain inexplicit in this case it is to be identified or recognized as everyday life examples of chemical and physical changes. A key takeaway from the discussion was the teachers' authority to re-sequence lesson objectives. Initially, some viewed the sequence of topics as fixed, with *Willie* arguing that the syllabus dictates the order of teaching: *"Colleagues, this is a syllabus and it guides you how you should teach a topic and the way the competencies placed is how you should teach them" (Willie).* However, the teachers resolved that it is the teacher's responsibility to sequence the competencies based on his or her judgment of concepts, when taught first will help learner learn the subsequent concepts with ease. As a result, the teachers proposed for instance; the third last competency; describe changes in everyday life and industry and classify them as chemical and physical changes. And the last basic competencies give examples of chemical and physical change or reactions in everyday life and industrial processes. Should be explored first; then will a teacher move to chemical reactions. This was a very important lesson on curriculum saliency that the teachers learnt. According to Mavhunga and Rollnick (2013), identification of concepts (changes in everyday life) that should be taught first, without which understanding of chemical changes, which involves reactions, would be impossible.

Findings from the Physical Science Learners' Textbooks

An analysis of two recommended Grade 8 Physical science textbooks was done. Our focus when analyzing the two learners' textbooks was on the depth of integration (superficial, moderate, and deep). We looked at the relevance of the illustrations used in the learners' textbooks to IK. **Figure 2** shows the teachers' learning during the workshop discussion on the learners' textbooks. The two textbooks that were analysed are; new physical science grade 8, Namibia Junior Secondary School Certificate by Britz and Mutasa (2010) as well as Living Physical Science Learners' Book by Jones et al. (2016). Before the analysing began, the teachers were asked as to which of the recommended textbooks do, they frequently use. All the participating teachers indicated that they frequently use the Living Physical Science Learners' Book.

Table 1. Syllabus requirement on chemical and physical changes: IK is identified as everyday life (Namibia MEAC, 2015, p. 12)

Topic 2 Matter	
General Objectives *Learners will:*	Grade 8 Specific Objectives *Learners should be able to:*
2.1 Nature of matter: physical and chemical changes	
• Know the nature and characteristics of physical change and chemical change, the three states of matter and the kinetic particle theory of matter	• Describe physical and chemical change • Distinguish between a physical and chemical change • Outline a chemical change by representation in general terms in the form reactants $\longrightarrow$ products • Give examples of chemical changes or reactions in everyday life and industrial processes • Write down chemical changes in the form of word equations • Describe changes in everyday life and in industry and identify them as physical or chemical changes (cross-reference to 1.3)

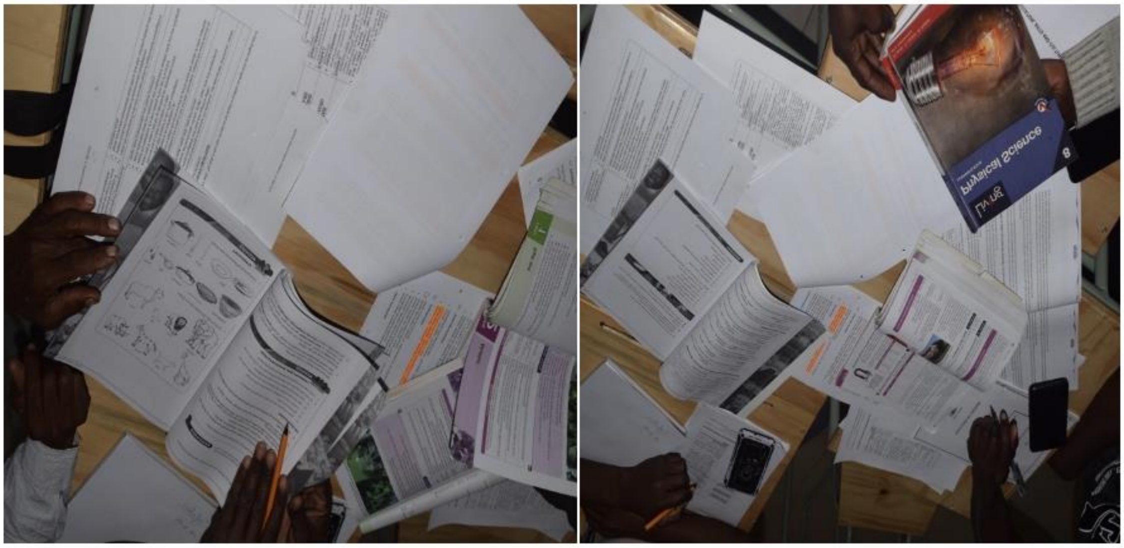

Figure 2. Teachers learning during the workshop discussion on the learners' textbook

Table 2. How the topic Chemical and Physical changes is presented in the two textbook

Textbook title	How chemical and physical changes are presented and what examples of indigenous knowledge or representations is contained
Jones, Larceda and Roebert (2016); Living Physical Science Learners' Book	⇒ Description of Physical and chemical changes ⇒ Chemical changes happen in chemical reactions • Write word equations for chemical changes Reactants $\longrightarrow$ products Iron + oxygen $\longrightarrow$ iron oxide • Examples of chemical changes given Baking, Rusting ⇒ Chemical changes in industry ⇒ Physical properties help us to identify substances Examples relevant to IK / everyday life examples Cooking an egg (everyday knowledge) Baking (everyday knowledge)
Britz and Mutasa (2010); New Physical Science grade 8	⇒ Physical changes Changes in the state of phase Forming mixtures and separating them ⇒ Chemical changes • Examples of chemical changes Burning wood, fermentation ⇒ Chemical changes in Chemical reaction Reactants $\longrightarrow$ products Wood + oxygen $\longrightarrow$ carbon dioxide + water + energy ⇒ Differences between physical and chemical changes tabulated Examples relevant to IK / everyday life examples Crushing Mahangu into Mahangu meal (Typical IK) Milk turning sour (Typical IK) Burning wood (IK /everyday knowledge) Fermentation to produce alcohol (Typical IK)

They further indicated that the textbook is the recent edition (2016) compared to a 2010 edition. Moreover, some teachers indicated that Living Physical Science its illustrations are colored and most of the examples used in it do come in final Examinations. **Table 2** summarizes how the topic chemical and physical changes is presented in each textbook. The teachers' discussions revealed some concerns regarding sequencing of learning contents. Living Physical Science Learners' Book, first presents the most abstract concept of chemical changes then later, presents physical changes. While New Physical Science grade 8 first presents physical changes which seem to have a lower cognitive demand on the learners. When it comes to local or IK representation, we learn that Living Physical Science uses examples that are more foreign to the learner's everyday life. In some instances when examples from everyday life are drawn, they remain very much modern (see **Figure 2**).

Examples such as baking and frying an egg may sound common, but a learner from a very poor family or most rural areas will find it harder to unpack and understand the processes behind, for instance, baking. On the other hand, in New Physical Science Grade 8, the teachers learn that most of the cited examples and representations are typically local or IK-oriented (see **Figure 3)** and are very much relevant to the African context. **Figure 3** shows a few photographs from the two textbooks.

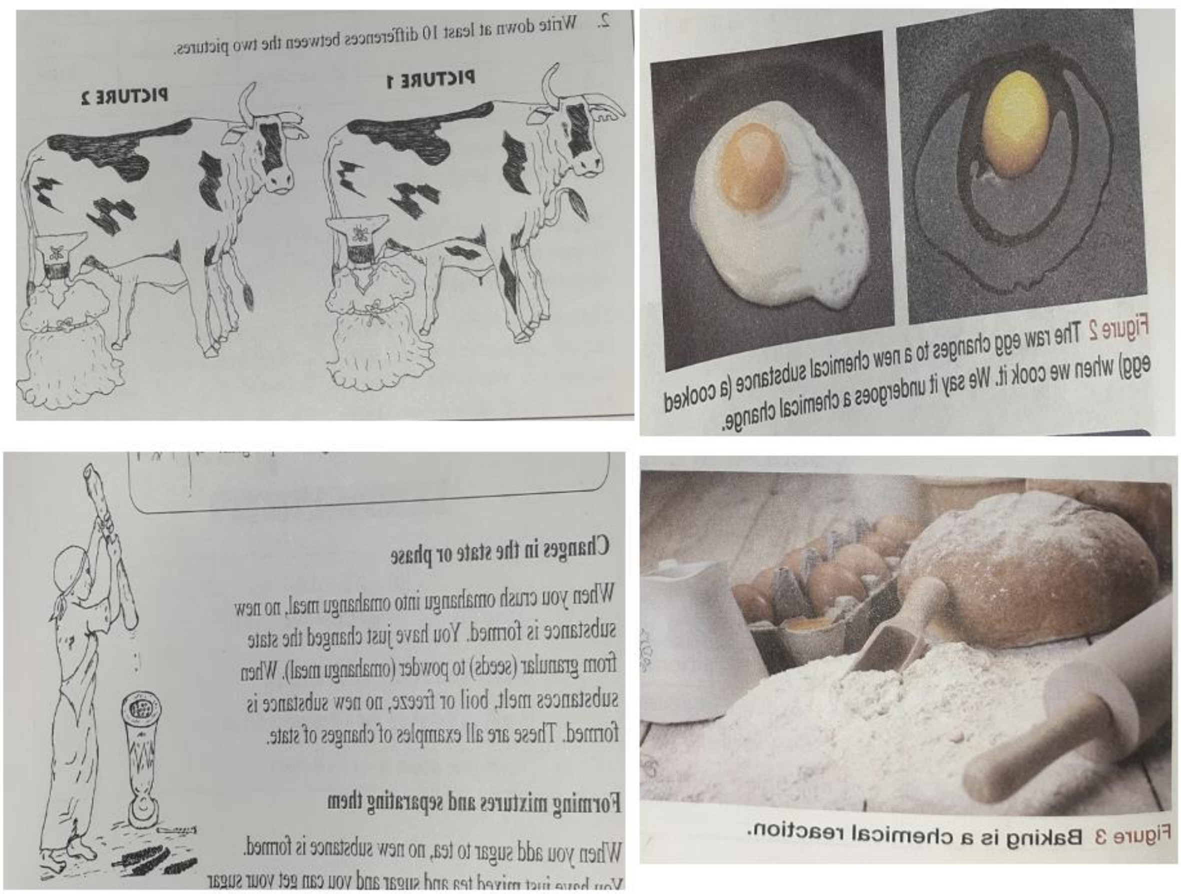

Figure 3. Illustrations of chemical and physical changes in the two textbooks (Jones et al., 2016); Living Physical Science Learners' Book Britz and Mutasa (2010); new physical science grade 8)

The findings from these textbooks show that the cultural identity of the authors plays a major influence on the context through which the subject content knowledge will be contextualized. It was Sipho who called our attention to the authors and publishers. It turned out that the Living Physical Science textbook is published for Namibia by Oxford University Press. This also explained the absence of typical local or IK representations in this textbook. The representations are expressed in a Western context by Western scholars. In these textbooks, living physical science is authored by professors from the United Kingdom, and these scholars expressed their culture or identity by baking bread and frying an egg. The teachers in these discussions further learned that the New Physical Science Grade 8 textbook is rich in local or IK because the textbook is authored by indigenous authors from Namibia.

Summary of Findings and Discussion

What lessons can grade 8 Physical Science teachers learn (or not) about chemical and physical changes integrated with IK through co-analyzing the curriculum documents?

This study has revealed that science teachers lack interest in reading curriculum documents; however, the study underscored the importance of teacher familiarity with curriculum documents. For instance, without a clear understanding of the NCBE, teachers struggled to integrate IK effectively. Teachers learned that they were required to use IK as learners' prior knowledge. Critically, the study has pointed out an important gap between policy and practice. Teachers' initial lack of awareness of IK integration in the curriculum meant they had not been incorporating it into their teaching. Whether Indigenous knowledge is authentically integrated into the science curriculum or merely mentioned superficially. Furthermore, the study has revealed, the extent to which indigenous knowledge integration in Namibian curriculum documents as superficial, Indigenous knowledge is only mentioned. Both the Namibian National Curriculum for Basic Education, Grade 8 Physical Science syllabus, and National Subject Policy Guide were devoid of depth and breadth.

For instance, the researcher and participating teachers discovered that both the NCBE, National Subject Policy, and the physical science syllabus implicitly encourage the use of IK through terms like "existing knowledge" and "everyday experiences." This ambiguity has led to varied teachers' interpretations and uncertainties. The learners' textbook analysis revealed that the depth of integration of IK in these materials depended on the author's cultural position. Locally authored materials (Mutasa, 2010) show significant depth of IK integration, while those authored by foreigners (Jones et al., 2016) were devoid of IK. An important take-home lesson from this study is that the successful implementation of IK requires teacher training, clear guidelines, and resources. By addressing these needs, educational stakeholders can foster a deeper connection between learners' cultural experiences and scientific knowledge, enhancing the overall learning experience.

Recommendations

The study recommends revising the NCBE curriculum, the Grade 8 Physical Science syllabus, and the National Subject Policy Guide to include explicit guidelines for integrating IK. There should be close collaboration during curriculum materials development with stakeholders, including teachers, indigenous knowledge custodians, and curriculum developers. This collaborative approach will ensure curriculum content is accurate, relevant, and culturally appropriate. The findings underscore the need to consider local context and IK when selecting educational resources to ensure effective learning. Additionally, I suggest implementing planned learning interventions, such as workshops, to engage science teachers and support them in gaining knowledge on integrating IK into science education. Further research can be carried out to find which indigenous practices offer means to integrate them with concepts in the school curriculum.

Conclusion

This study highlights the need for professional development in order to emerge IK that is relevant to bring about deep learning. The ideas that emerge are useful to support teachers in bridging the gap between curriculum formulation and implementation. The study has both strengths and weaknesses in the amalgamation of subject matter knowledge with instructional practice, which was figured out by teaching and learning observations as well as semi-structured interviews with four science teachers. There is a concluding reflection on the whole study that restates the importance of focusing on the pedagogical content knowledge needed in science education, as well as the presence of possible interventions that will improve the outcomes for learning and teaching.

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