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Secondary School Life Sciences Teachers' Understanding of Indigenous Knowledge in Relation to their Views on its Integration into their Classroom Practice

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The purpose of this study is to explore the relationship between life sciences teachers' understanding of indigenous knowledge (IK) and their views of integrating Indigenous Knowledge in their teaching practice. A qualitative case study research approach was adopted, and purposive sampling strategy was used to select eight Grades 10–12 life sciences teachers in three peri-urban high schools. The Knowledge Synthesis model by Barnhardt and Kawagley is used as a framework for this study. Questionnaires and interviews were employed to collect qualitative data. Findings revealed that if teachers understand IK primarily as a body of inherited wisdom, they see the possibility of integration of IK as the use of local knowledge of the learners, as IK illustrations of life sciences curriculum constructs or as no integration in the science classroom at all. The latter group of teachers consider IK as an inherited body of knowledge in parallel with western science. If inclusion of IK is mandated, they suggest presenting IK separately, preferably by IK custodians. If teachers consider IK primarily as a holistic knowledge system including the physical and metaphysical world, they see integration opportunities at system level, for instance in teaching sustainability. Lastly, if IK is seen as a body of loosely connected science concepts, integration is possible where these concepts appear in the science curriculum documents. This study recommends that teachers should be involved in educational policy decision making since they have first-hand experience of learners in the classrooms and are involved with curricular and school matters. The implication of the findings from this study to science education is that the integration of both worldviews can be used as a tool to enhance science learning among high school learners taking life sciences by ensuring a culturally relevant science classroom.

Keywords: *Indigenous knowledge; westernised science; integration; culturally relevant practice; life sciences teaching*

The goal of science education is to make science accessible and attractive to learners in the classroom. According to the South African Department of Basic Education (2012), in the African indigenous context this intention calls for the inclusion of indigenous knowledge (IK) in the science curriculum. The integration of IK with science in the classroom is likely to make teaching and learning of science more attractive and meaningful to learners from diverse socio-cultural backgrounds (Ezeanya-Esiobu et al., 2021). There have been studies on teachers' perceptions and views of IK (Naidoo & Vithal, 2014; Ahanonye, 2021). However, the relationship between teachers' understanding of IK and their views of the possibilities of integrating IK with westernised science (WS) in the science classroom is yet to be studied. Therefore, the focus of this study is to explore the relationship between teachers' views regarding IK and the possibilities of integrating such knowledge with science teaching and learning as part of their classroom practice. In a culturally diverse classroom, Laughter and Adams (2012) posited that science should be made interesting to all learners to ensure an

effective classroom teaching and learning of science. It is important that a teacher provides learners, who are from the indigenous context, with the opportunity to learn science from their culturally diverse worldviews. In addition, the Subject Specific Aim 3 of the South African National Curriculum and Assessment Policy Statement (CAPS) policy document 'relates to understanding the applications of life sciences in everyday life, as well as understanding the history of scientific discoveries and the relationship between IK and science' (Department of Basic Education, 2012: 13). Therefore, teachers' IK and their views on the possibilities of integrating such knowledge with their science teaching, as required by the curriculum, are the key focus in this study. Consequently, the following research question was posed: what is the relationship between life sciences teachers' understanding of IK and their views on integrating IK within their teaching practice?

Background and Literature Review

Indigenous knowledge is defined by different scholars differently. Emeagwali (2014) defined indigenous knowledge as a body of knowledge that is interconnected with both non-material and spiritual spheres of existence. Indigenous knowledge involves techniques, practices, values and beliefs that have been accumulated in a particular locality for decades without the intrusion of external hegemonic systems. It is still in use locally by the indigenous people and in the western world through integration.

Emeagwali and Shizha (2016) expand on this definition by stating that IK is an everyday lived experience of the local people, that is, people who live within a particular geographical area, and it involves decision-making, formal and informal education, systems of classification, social interaction, scientific knowledge and the preservation of nature within their cultural milieu. They claim that scientific knowledge exists in all societies and cultural milieus, irrespective of their ways of life. Every society has its way of life, history and culture, and it adopts various ways to live and demonstrate their knowledge which is unique to this society. For example, the western indigenous science is unique to the western culture, while the African indigenous science is unique to African culture.

The South African curriculum 'promotes knowledge in local contexts, while being sensitive to global imperatives' (Department of Basic Education, 2012: 4). The policy document calls for the inclusion of IK into science teaching and learning in the classroom. One of the principles found in the curriculum encouraging the integration of IK and WS is 'valuing indigenous knowledge systems: acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution' (DBE, 2012: 5). The CAPS emphasises the incorporation of IK into the classroom to promote a culturally relevant science teaching. In this way, IK is seen as core to teaching and learning activities within the science classroom, and it often relates well with the concepts of the formal curriculum.

However, Le Grange (2007) sounded caution by noting that 'for non-western learners, interaction between two worldviews characterises much of their school experience, complicating the learning process and potentially resulting in cognitive conflict or as the literature describes it, cognitive dissonance/perturbation' (p. 581). Learners with indigenous backgrounds are likely to experience conflicting ideas between westernised science and their existing local knowledge because the school context is the first place they experience an interaction of both worldviews. Therefore, science teachers should be aware of such interaction, as well as understanding the complications it could cause for learners during the learning process (Le Grange, 2007). Some other issues that may hinder the appropriate integration of IK and westernised science could stem from teachers not knowing how to integrate both worldviews in their science classroom because the curriculum does not explicitly state how both worldviews could be integrated (Ahanonye, 2021). Diwu and Ogunniyi (2012) posited that these tensions have been linked to the incompatibility of both worldviews in terms of their differences in epistemology, ontology and assumptions.

In their study on the effect of an argumentation-based course, Ogunniyi and Hewson (2008) found that 'although the teachers showed increased willingness to teach IK as part of school science, some of them were either speculative or did not provide sufficient hints at how they would do this' (p. 171). However, the authors observed that the course helped teachers to become more aware of the need to

integrate both worldviews, and of the appropriate context in which they can be used. Cronje et al. (2015) investigated South African science teachers' views on IK, and they found that most of the teachers had a partially informed view of the nature of IK. Similarly, Mavuru's (2022) study on reimagining indigenous knowledge in a multicultural science classroom revealed that most of the science teachers' understanding of the nature of IK was incomplete, which hindered the meaningful integration of IK. This shows that irrespective of teachers' awareness and willingness to integrate IK and WS, more research needs to be done to understand how both worldviews are or can be integrated during classroom teaching and learning to promote learner access to science. Zinyeka et al. (2016) used a truth-based epistemological framework to enable teachers to successfully integrate IK into their science teaching. They revealed that this framework facilitated science teachers' views of IK in a way that it can be easily integrate into their science teaching. This research focus is particularly needed within the South African context since integration of IK into science teaching within schools is mandated by the CAPS.

For decades, African indigenous knowledge systems have been in existence, and had their own educational system before the introduction of western education by European missionaries and colonialists. The main origin of the presently acknowledged westernised science was from Europe, which then spread across the rest of the continents, and is used as a framework for learning presently. Le Grange (2007) posited that even though westernised science is still generally seen as being superior to other IK because it is acknowledged as a universal and culture-free knowledge, initiatives are currently being developed to integrate IK with westernised school science. These initiatives may address the fact that when westernised science is 'quite often presented as neutral, judgment-free and apolitical, it masks the ongoing silencing and marginalising of non-dominant students in science classrooms' (Smith et al., 2022: 638). Shizha (2013) termed this view a 'colonial mentality' where one worldview dominates the other.

Scientists view the westernised Nature of Science (NOS) as scientific knowledge that is durable. Its tentative nature depends greatly on experimental evidence which is affected by social and historical contexts (Cronje et al., 2015). Just like the NOS, the Nature of Indigenous Knowledge (NOIK) also has its tenets which are suggested in the NOIK framework (Cronje et al., 2015). Indigenous knowledge has been in existence over centuries, and it is recognised as a cultural, traditional and ecological knowledge. According to Le Grange (2007) and Cronje et al. (2015), IK is inferential, tentative, can be observed and involves historical, social and cultural milieu. Cronje et al. (2015) posited that the NOIK framework involves epistemology, ontology, volition, axiology and methodological domains which are entwined and inseparable. The authors suggested the need for science teachers to acknowledge the NOIK as a contextualised and holistic worldview just like they would with the NOS.

Nevertheless, science teachers often perceive westernised science and IK as two conflicting paradigms (De Beer & van Wyk, 2012), although their paradigmatic levels are still very similar to each other. Integrating IK and westernised science to create a balance in the classroom could be a challenge to science teachers who have the intention of incorporating both worldviews in their science classroom. Comparing these two knowledge domains or paradigms could help in solving most of the issues emanating from their integration. In contrast, De Beer and van Wyk (2012), Barnhardt and Kawagley (2005) and Shizha (2013) share the view that both knowledge domains complement each other. They believe that IK and westernised science can be synthesised for a successful integration. For example, Figure 1 presents the Knowledge Synthesis Model developed by Barnhardt and Kawagley (2005).

Barnhardt and Kawagley's (2005) model represents the worldviews distinctive to each of the knowledge systems (IK and westernised science) and their shared characteristics. The model is based on four foci of these knowledge systems, i.e. organising principles; habits of mind; skills and procedures; and knowledge. There are horizontal divisions across the two intersecting circles. Therefore, these four foci manifest themselves in both IK (here labelled Native Knowledge Systems) and WS. For instance, habits of mind are manifested in IK by trust in inherited wisdom and respect for all thing, whereas in WS habit of mind is manifested by scepticism. The habits of mind of honesty, inquisitiveness, perseverance and open-mindedness are common ground to both knowledge systems. Note that each of these four foci has a common ground between the IK and WS. This is to show that to some extent both IK and westernised science share similar characteristics, which could provide

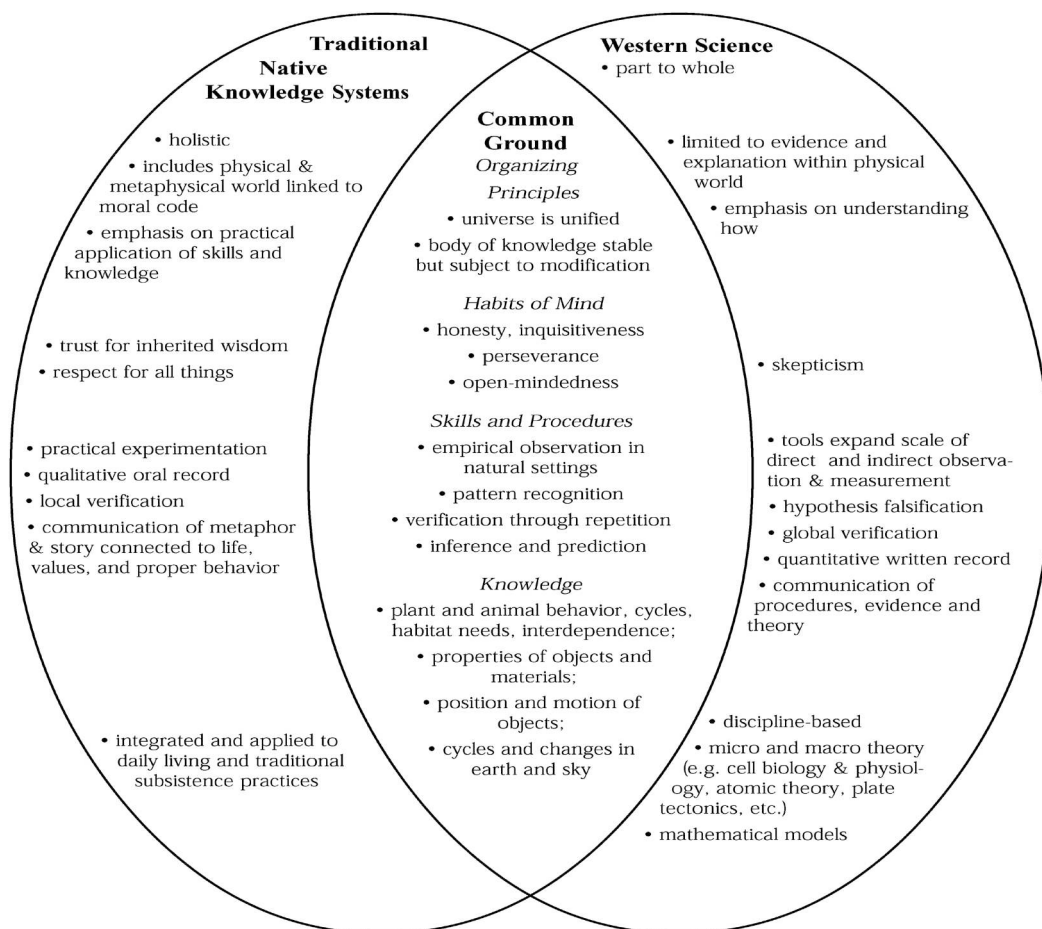


Figure 1. Barnhardt and Kawagley's (2005) Knowledge Synthesis Model.

teachers areas to integrate both worldviews during the teaching and learning of science. This study focused on exploring the relationship between teachers' understanding of IK and their views of the possibilities of integrating IK with science. Barnhardt and Kawagley's (2005) knowledge synthesis model was adopted as the theoretical framework for this study.

Methodology

A qualitative interpretive research paradigm was used to collect data from teachers. A purposeful sampling method was adopted for this research. This study involved a multiple case study because data were collected from eight teachers in three peri-urban township school contexts in Johannesburg, South Africa. The eight teachers taught Grades 10–12 life sciences, and included South African male and female science teachers who had at least three years of experience with teaching life sciences. The teachers are multi-lingual, that is, they are fluent in English, IsiZulu and Shona. A questionnaire was administered to participating teachers to access their views of IK. The open-ended questionnaire items focused on eliciting teachers' views of IK and of the possibilities of the integration of IK into their teaching practice. This was followed by an in-depth interview with each teacher on an individual and face-to-face basis.

The questionnaire for this study was adapted by the authors from an existing instrument by Cronje et al. (2015), and it was administered to explore teachers' views of the NOIK and NOS. To ensure the feasibility and validity of the questionnaire within the context of the peri-urban schools, the questionnaire comprising 11 open-ended items was piloted. The responses from the pilot study revealed that the questions were not ambiguous and were suitable for the study. Thirty-eight questionnaires were given out to participants in the three peri-urban schools, but only 21% of the questionnaires were returned by participants, i.e. eight teachers responded. The questionnaire focused on identifying the teachers' perceptions about their teaching practices for life sciences, their views on IK, and the possibilities of integrating such knowledge with their science teaching in the classroom context. The questionnaire responses were analysed and then used as a foundation for conducting interviews to further elicit the teachers' understanding of IK and their views of integrating IK in their teaching practice. The interviews were audio-recorded and transcribed verbatim. Ethics approval (H18/10/02) was obtained for this study from the institution commissioning the study. Permission was additionally sought from the Gauteng Department of Education, and approval was obtained for the research to be carried out in schools. The participants were given pseudonyms such as T1, T2, T3, T4, etc., to maintain their anonymity. Participation was voluntary, and participants were aware that they were free to withdraw from the research anytime they wished. Data from this study were triangulated to ascertain the feasibility and trustworthiness of the study.

A thematic analysis was adopted to analyse the responses from the questionnaire as detailed earlier on. This helped to understand teachers' IK awareness, and the possibilities of integrating such knowledge with westernised science in the classroom. The transcribed responses from the questionnaire and interviews were coded by assigning emerging themes from the data; these themes were adopted from the knowledge synthesis model by Barnhardt and Kawagley (2005). The responses from participants were broken down into codes in tables, and then themes were formed. From the codes, reoccurrence of certain responses was further broken down into themes using Barnhardt and Kawagley's (2005) various foci in IK and WS respectively, and between both worldviews. The four foci are: organising principles; habits of mind; skills and procedures; and knowledge. These foci were used to analyse teachers' responses from questionnaires and interviews.

Results and Findings

This section entails results and findings on teachers' understanding of IK and their views of the possibilities of integrating IK into their teaching practice. To elicit teachers' understanding of IK, several questions were asked regarding their views of the nature of IK. Responses were classified according to each of the four foci of Barnhardt and Kawagley's (2005) Knowledge Synthesis Model. Separately, teachers' views were solicited about the possibilities of integrating IK with life sciences teaching and learning in a scientific way. For each respondent these responses were then related to the individual's understanding of IK.

Focus 1: Organising Principles

This focus of the analysis deals with how IK (with its scientific characteristics) is considered to be holistically linked to the physical and metaphysical world by a moral code. IK may share certain ideas with western science, as the universe is unified (Barnhardt & Kawagley, 2005).

Several teachers characterise IK in terms of its organising principles. Firstly, T1's understanding of IK is that 'I have to understand the skills and philosophies developed by societies with a long history of interaction with my natural surroundings. Indigenous knowledge has valuable insights to implementing efficient uses of our land and spiritual relationships with nature'. When asked of the possibility of integration, T1 suggests that integration of IK in teaching science can draw on the common organising principles between the two knowledge systems. He explained that 'Indigenous knowledge is inextricably linked to a global sustainability ... Students can be taught to sustain life and protect our planet, not to exploit it. Conservation of energy and resources and learning about sustainability are essential'.

T1's understanding of IK and of the opportunities for integration of IK in science teaching centre consistently around the organising principles of both knowledge systems, i.e. the holistic nature of IK and the principle of the unified nature of the universe common to both knowledge systems. For T1, integrating IK and western science will promote understanding of nature and all its resources, hence, the need to preserve it. In contrast, T2 understands IK to be the 'Knowledge about science as seen or known and practiced in different cultures or racial groups'. When asked if IK can be used to explain life sciences concepts, she refers to traditional medication for tooth ache and nose bleeds. According to T2's understanding, IK has scientific knowledge (knowledge of the natural world) embedded in it, and this scientific knowledge exists among different cultural groups in the society, indicating that the universe is unified in nature. From the response above, T2's understanding of IK could have influenced her idea of integration that IK can be used to teach life sciences in the classroom owing to its scientific nature. T3's understanding of IK similarly indicates that 'It is the knowledge that existed within a specific cultural context that was acquired through series of informal experiments and intimate understanding of the environment'. When asked about IK integration, the response was that 'examples from home can help learning of life sciences effectively'. Thus, T2 and T3 see the need to make learners understand that science exists in their various cultures, and within their immediate environment by referring to certain plants for medicine, therefore arguing that IK should be made accessible to them in the science classroom. T2 and T3's understanding of IK influenced their views of integration by enabling learners to understand that the practice of medicine started way before the introduction of western science, hence, there is a link between both knowledge areas. Learners whose cultural practice involves the use of medicinal plants to cure ailments will relate easily to science teaching in the classroom. Responses from these teachers show their understanding of IK as knowledge that is metaphysical and embedded with practical skills. Their view of IK as a scientific knowledge that involves various skills, principles and philosophical underpinnings of the indigenous people within their natural surroundings is an indication that the universe is indeed unified.

Focus 2: Habits of Mind

This focus of analysis explores the views of IK as wisdom that has been passed from one generation to the next within a specific locality and culture. This view of IK may facilitate integration in science teaching by emphasising the habits of mind common between IK and westernised science, such as honesty, inquisitiveness, perseverance and open-mindedness (Barnhardt & Kawagley, 2005).

The teachers in this study (T2, T3, T4, T5, T6, T7) most frequently see habits of mind as the main characteristic of IK, particularly the fact that IK is culture and locality specific. However, none of the teachers specifically mention the four common habits of mind listed in the previous paragraph as opportunities for integrating IK in science teaching.

When describing IK, T4 is of the view that IK is the 'Local and traditional knowledge embedded in local communities, cultural traditions. It is knowledge deeply rooted in science that has been passed down from generation to generation, and it is deeply rooted in history.' When asked about the integration of IK T4 referred to specific concepts (knowledge) and explained that 'most concepts in life science we know have a rich history in tradition, which western science has modified to the science we know today (e.g. fermentation)'. T4's idea of IK informs his views of integration in the sense that he believes that IK is a local and traditional knowledge practised by members of a community for centuries; hence, there is need to use the same knowledge to make science accessible to learners in the classroom. This will enable learners to understand that most of their everyday lived experiences are related to school science. Similarly, T6 indicates that IK is the 'Information that has rooted from cultural background of authentic tribes that defines diversified people according to their original traditions'. T6 sees the potential for integration by saying that 'IK and life sciences are both based on nature; hence they correlate. Healing flu for instance is taught during life sciences and this knowledge was passed through generations to generations.' T6's understanding of IK resonates with T2 and T4's idea of IK. T6 understands the relationship that both worldviews share; hence, this influences his idea of integration of both worldviews. T6's response indicates that certain concepts in the curriculum are part of indigenous culture, and should be linked with IK to

preserve the cultural knowledge of the indigenous people. T5 slightly agreed on the possibilities of integrating both worldviews, but she reiterated that 'Learners should be made aware of its (IK's) existence, but decisions solely rest with them'. The responses provided by most of the participants are an indication that they understand that IK and life sciences are similar in their philosophical underpinnings and both can be linked to make science accessible to learners in the classroom. However, T2 and T5 opined that if IK must be introduced during science lessons, it may be done by elders or traditional healers, and it is the learners' choice if they wish to merge their cultural knowledge with science.

Focus 3: Skills and Procedures

This focus of analysis is based on the views on scientific skills and procedures embedded in the NOIK and NOS as discussed earlier. T7's understanding of IK is that 'it is knowledge that has sustained our forefathers for many years ... there's definitely a need to uphold the status of this knowledge because, it's very still in existence, and we still live by it'. The view of the possibilities of integration presented by T7 is that IK can serve 'as a means to help learners learn how to evaluate evidence in light of advanced claims'. This view presented by T7 buttresses the idea of using IK to help learners to learn certain scientific skills in the classroom, such as the tenets of the NOS; however, evidence must be presented in the form of examples. In resonance to this response, T8 opined that 'Examples from the experiences from home can help life sciences learning effectively'. T8 believed that all individuals are an embodiment of their culture hence positing that the prior knowledge learners bring to the classroom can be probed and used as a link to teach life sciences in the classroom. According to T8, 'when I teach, I am able to explain concepts in science using IK, because I think there is definitely a link there. I think modern science exists from IK'. T4 and T8 agreed with the idea of integration and provided some examples of the IK ideas which can be linked easily to life sciences concepts. From a different perspective, T5 suggested that 'it can be taught whereby herbalists can be invited into classrooms to demonstrate the diversity in plants; this is a chapter in Grade 10 CAPS [curriculum]'. Since teachers are encouraged to make connections with learners' cultural and lived experiences to make learning more meaningful in the science classroom, T5's idea could enhance such teaching practices in the science classroom.

Focus 4: Knowledge—Indigenous Way of Knowing

This focus of analysis deals with teachers' views regarding traditional practices and ways of knowing in relationship to western ways of knowing. It talks about how organisms and objects exist in nature. For some teachers, IK is a way of knowing and must be integrated with science owing to its unique nature. T2 states that IK includes 'a breakthrough in the use of medicinal plants in treating ailments and disorders', and elucidated that 'the use of medicinal herbs to cure minor ailments, e.g. tooth ache, nose bleeding' can be used as an example for teaching science in the classroom. Similarly, T6 indicates that 'Indigenous plants such as devil's claw and African potato, also rooibos, are used as home-based knowledge' and later states that 'we can use indigenous knowledge as prior knowledge to build up on abstract scientific concepts. For instance, in a topic respiration, IK such as bread making and Umqombothi (African beer) can be used to demonstrate the importance of IK.' Making reference to the reaction of yeast cells during baking and in brewing local beer seems to be a great example for teaching respiration. This idea will enable learners to link their prior knowledge to school science.

On a different note, T5 understands IK as 'the use of cultural knowledge to develop the mind of local people who are not educated but have an idea of traditional ideas'. However, on the aspect of integration, he opined that 'some concepts have the knowledge that is only cultural and traditional'. T5 understands IK as cultural knowledge that is unique to people of a certain locality, and this seems to be an acknowledged notion of what IK represents. However, T5 also believes that IK is 'knowledge for the uneducated'. In this case, T5 believes that to be educated means to attend a formal school, and this could affect how he integrates this indigenous knowledge. T5 marginally considers the possibility of IK integration by stating that certain concepts have traditional information that could enable a

successful integration. The implication of his understanding of IK to integration is likely to mean that T5 integrates IK with some concepts, and then ignores the integration of IK while teaching other concepts. On the aspect of integration, when asked how IK could be integrated with life sciences, T7 opined that 'If there is an IK account of a specific life sciences topic, it should be used to show how IK's evidence(s) account for theories compare with western science content knowledge'. From her understanding, it is evident that she believes that IK is a body of knowledge that has been in existence and is still valid to date. She opined that the IK resources that have been gathered and documented should be utilised for this purpose, to make science accessible to learners and to encourage learners' interest in science. However, some of these IK materials are not made ready for science teaching, and this could be a barrier for a successful integration of IK. Teachers' understanding of IK could be a key factor to how they unpack and enact their lessons as teachers in this study indicated. It is interesting that even when many teachers agree that the main characteristic of IK is in the habits of mind (local wisdom passed down from generation to generation), several of these teachers have suggestions of different foci for integration of IK and western science.

Discussion

To buttress the argument on teachers' understanding of IK in relation with their views of the possibilities of integrating both IK and westernised science, it is imperative to understand South African science teachers' ideas of how they ensure that all learners are catered for during their teaching practice. Teachers' understanding of IK could be viewed as a factor in enhancing scientific knowledge and making science accessible to all learners in the classroom, as revealed in the findings of this study. In this study, teachers' understanding of IK is motivated by their socio-cultural lived experiences and beliefs, and these experiences and beliefs inform their views on how IK can be integrated in the classroom (Sjöström, 2018). Some of the participants understand IK as cultural knowledge that is unique to people of a certain locality, and this notion seems to be in line with the key characteristic of IK as opined by Emeagwali and Shizha (2016). Teachers such as T1, T4, and T7 believe that most cultural practices have been passed on from one generation to another. Some of the traditions and cultural practices are communicated through imitations, repetitions and rituals that the people of the community can retain, and passed down to other generations (Cronje et al., 2015). From teachers' understanding, the principles and underpinnings guiding IK are related to indigenous people's interaction with their natural surroundings and how these principles have enabled them to develop cultural skills that have been in existence for generations (Emeagwali, 2014). Teachers' understanding of IK put together resonate with Barnhardt and Kawagley's (2005) and Ezeanya-Esiobu et al.'s (2021) position on IK as a knowledge that is embedded with practical skills, innovation (scientific knowledge) and metaphysical (spiritual) experience.

The knowledge of IK portrayed by the participants of this study, such as T1, T2, T3, T4 and T5, links with their views of integration, whereby they suggest that IK as traditional knowledge can be used to teach life sciences in the classroom owing to its scientific nature, uniqueness to culture and philosophical underpinnings (Emeagwali & Shizha, 2016; Sjöström, 2018). This resonates with Emeagwali and Shizha (2016), as they posited that scientific knowledge exists in all cultural milieus and every society has a culture, history and ways of life. Furthermore, they opined that IK can be integrated with life sciences to conserve nature by teaching the concept of sustainability in the classroom. In relation to this, suggestions have been made by scholars such as Eilks and Hofstein (2014) that IK may provide the link between sustainable development and science education, with its potential to impact the three domains of relevant science teaching such as personal relevance (deals with consumption of resources), societal relevance (deals with individuals participating in the issues of sustainable development in the society) and vocational relevance (engaging in careers relating to sustainable development; Sjöström et al., 2015). Therefore, when learners learn about IK in the classroom, it enables them to recognise the intimate connection that exists between nature and humans in their cultural context (Zidny et al., 2020). Some teachers believe that western science emanated from IK; therefore, both should be allowed in the classroom. With such understanding, the teachers

indicated the need for integration by emphasising that IK varies among learners owing to the uniqueness of their various cultures (Emeagwali & Shizha, 2016). Therefore, integrating IK with westernised science by probing learners' prior knowledge will help to develop their cultural pride and appreciate the importance of science (Laughter & Adams, 2012; Østergaard, 2017). This according to Underwood and Mensah (2018) is a teaching practice where teachers adopt a culturally relevant science teaching to ensure that all learners develop higher-order thinking skills and positive attitudes towards science learning (Zidny et al., 2020). The classroom is a social environment where learners bring their diverse socio-cultural beliefs and experiences (Zidny et al., 2020) because IK is socially constructed based on the experience of the indigenous people located within a certain geographical area (Moulaison Sandy & Bossaller, 2017). It is evident that teachers' understanding of IK could influence their ability to integrate IK and westernised science, as they connect scientific concepts with learners' everyday experience (Zidny et al., 2020), thereby helping them to make connections with their cultural identities. Furthermore, since IK is known to cover all spheres of life, teachers should incorporate those aspects that are scientifically relevant to the concept being taught, such as medicine, agriculture, climatology, sustainability, fishing, forestry, etc. (Sjöström et al., 2015). From Cronje et al.'s (2015) perspective, 'Indigenous knowledge holds affordances for conceptual development of learners in the science classroom, since this cultural knowledge often serves the formal curriculum concepts well' (p. 319).

The stance of participants such as T2, T4, T6 and T8 on the relationship between IK and westernised science is characterised in Cronje et al. (2015) and Regmi and Fleming (2012) as complementary worldviews. They emphasised that IK and westernised science each have science embedded in them and certain similarities are shared by both worldviews (Cronje et al., 2015; Zidny et al., 2020) and therefore can be integrated in the classroom context. Regmi and Fleming (2012) indicated in their study that scientific concepts are contextual and conditional in nature, just like some of the teachers reiterated. Therefore, IK should be integrated with western science in the classroom, to improve the growth of scientific literacy considering the multicultural nature of the South African classroom (Emeagwali & Shizha, 2016; Mavuru, 2022). The teachers believe that the indigenous culture and beliefs learners bring to the classroom can be used to provide them with an adequate 'entry point into the scientific world' (De Beer & Mothwa, 2013). Science is embedded in IK, and both worldviews can be linked to each other in the classroom by making examples from the cultural knowledge that learners bring with them (Regmi & Fleming, 2012; Underwood & Mensah, 2018). This was also the idea of the teachers who participated in the study conducted by De Beer and van Wyk (2012), as most of the teachers only used IK as examples in their science classroom. The idea of teaching respiration by making reference to the reaction of yeast cells during baking and local beer brewing by T8 is a way of integrating both worldviews and making science accessible to all learners (Zidny et al., 2020) in the classroom. This could be a way of demonstrating the idea of science in IK without making science appear like knowledge that is meant for just one culture, instead being for diverse cultures (Emeagwali & Shizha, 2016) in a multicultural classroom. The teacher who linked the concept of respiration to the brewing of African beer (Umqombothi) was making science relevant not only to South African learners alone, but also to all other learners in the classroom by making them understand that they practise unique scientific skills in their everyday experience. This practice according to Underwood and Mensah (2018) is known as cultural competence, that is, when a teacher links the concept being taught in the classroom to learners' everyday experiences. According to teachers' responses the use of different approaches to teach science can be said to be that of the integrationist approach as indicated by Naidoo and Vithal (2014).

On IK integration, teachers do not have the same way of integrating IK in their lessons. While some of them see the possibility of integration as common organising principles (T1, T2, T3), the majority view it as linking with different topics in science and giving IK examples to illustrate these topics (T1, T2, T4, T6 and T8). T5 and T7 indicated that IK is a specific type of knowledge, thus integrating it with sciences is hardly possible, and they were quite negative about its integration. T5 specifically mentioned that IK is for the uneducated, that is, people who did not go to school, and it does not need to be applied in science. T7 indicated that there is a need to present it, but not integrate it, that the learners should make their own choice whether they want

such knowledge or not. These two teachers mentioned that, if one must bring IK into the classroom, spiritual healers or herbalists could be invited to bring such practices to the school. However, they believed that it is not related to science, it is just a way of presenting IK. These responses resonate with the findings by De Beer and Mothwa (2013) on how to use ethno-botany with scientific rigour to teach life sciences in the classroom. Similarly, T7 said that we can use IK as comparative evidence, that is, not integrating but comparing both worldviews.

The Knowledge Synthesis Model by Barnhardt and Kawagley (2005) provides for the focus of skills and procedures of IK which includes communication of metaphor and stories connected to life, and proper behaviour. However, the teachers did not mention these aspects in their responses. Similarly, the skills and procedures of IK amount to an oral record as the way of communicating IK; however, the teachers did not mention it in their responses. Findings from this study show that teachers' understanding of IK is a key factor for a successful integration of IK and westernised science in the classroom using different teaching strategies. However, the curriculum needs to emphasise the importance of integration, and how this needs to be done (Ahanonye, 2021) by introducing various cultural concepts and involving teachers in policy reform.

Conclusion

This present study shows that teachers are an embodiment of IK and they believe that both worldviews are related and have science embedded in them. Therefore, this knowledge can be used as a tool to bridge the gap in science learning and making science accessible to all learners from different contexts. Teachers' understanding of IK impacts their views of the possible ways IK can be integrated in the science classroom as they emphasise that IK is a cultural knowledge deeply rooted in science, but also a metaphysical and non-static knowledge passed on from one generation to the next. These findings of the relationship between teachers' understanding of IK and their views of the possibilities of integrating IK in their classroom could create more awareness of the necessity of policy change and empowering teachers on how IK and western science can be incorporated in the classroom for a more culturally relevant science classroom in the South African milieu. This study recommends that teachers should be involved in policy reform and should not be ignored because they have first-hand experience and access to learners, and therefore can understand what works and does not work in classroom practice. This means that teachers' experience of IK integration like that indicated in this study could help with curriculum reform whereby certain IK concepts could be absorbed into the curriculum. In addition, the curriculum should be indigenised by explicitly stating examples of IK and how it could be integrated in the science classroom to enable teachers who are not familiar with IK concepts to integrate both worldviews. This study will inform teachers' pedagogical practices as they become more aware of the need to integrate IK and western science in their classrooms. The implication of findings from this study to science education is that the integration of both worldviews can be used as a tool to enhance science learning among high school learners taking life sciences and ensure a culturally relevant science classroom.

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References

Ahanonye, U. A. (2021). *Teachers' indigenous knowledge and the possibilities of integrating it with life sciences teaching and learning*. Unpublished doctoral dissertation, University of the Witwatersrand.

- Barnhardt, R., & Kawagley, A. (2005). IK systems and Alaska Native ways of knowing. *Anthropology & Education Quarterly*, 36(1), 8–23.
- Cronje, A., De Beer, J., & Ankiewicz, P. (2015). The development and use of an instrument to investigate science teachers' views on IK. *African Journal of Research in Mathematics, Science and Technology Education*, 19(3), 319–332.
- De Beer, J., & Mothwa, M. (2013). Indigenous knowledge in the science classroom: science, pseudoscience, or a missing link? In *Proceedings of the 3rd International ISTE 2014 Conference*, 452–467.
- De Beer, J. J., & Van Wyk, B.-E. (2012). Indigenous knowledge in the life sciences classroom: Science, pseudo-science or a missing link? *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie*, 31(1), 5.
- Department of Basic Education (2012). *Curriculum and assessment policy statement (CAPS). Further Education and Training Phase Grades 10–12*. <http://www.education.gpg.gov.za>.
- Diwu, C. T., & Ogunniyi, M. B. (2012). Dialogical argumentation instruction as a catalytic agent for the integration of school science with Indigenous Knowledge Systems. *African Journal of Research in Mathematics, Science and Technology Education*, 16(3), 333–347.
- Eilks, I., & Hofstein, A. (2014). Combining the question of the relevance of science education with the idea of education for sustainable development. In I. Eilks, S. Markic, & B. Ralle (Eds.), *Science education research and education for sustainable development* (pp. 3–14). Shaker.
- Emeagwali, G. (2014). Intersections between Africa's indigenous knowledge systems and history. In G. Emeagwali & G. Devi (Eds.), *African indigenous knowledge and the disciplines* (pp. 1–17). Sense.
- Emeagwali, G., & Shizha, E. (2016). Interconnecting history, African indigenous knowledge systems and science. In G. Emeagwali & E. Shizha (Eds.), *African indigenous knowledge and the sciences* (pp. 3–12). Brill.
- Ezeanya-Esiobu, C., Oguamanam, C., & Ndungutse, V. (2021). Marginalisation of Indigenous knowledge in African education: The case of Rwandan traditional medicinal treatments for livestock. Open African Innovation Research Working Paper 24.
- Laughter, J. C., & Adams, A. D. (2012). Culturally relevant science teaching in middle school. *Urban Education*, 47(6), 1106–1134.
- Le Grange, L. (2007). Integrating western and indigenous knowledge systems: The basis for effective science education in South Africa? *International review of education*, 53(5), 577–591.
- Mavuru, L. (2022). Reimagining indigenous knowledge in a multicultural science classroom. *International Journal of Inclusive Education*, 26(1), 1–17. <https://doi.org/10.1080/13603116.2022.2127498>
- Moulaison Sandy, H., & Bossaller, J. (2017). Providing cognitively just subject access to indigenous knowledge through knowledge organization systems. *Cataloguing & Classification Quarterly*, 55(3), 129–152.
- Naidoo, P. D., & Vithal, R. (2014). Teacher approaches to introducing indigenous knowledge in school science classrooms. *African Journal of Research in Mathematics, Science and Technology Education*, 18(3), 253–263.
- Ogunniyi, M. B., & Hewson, M. G. (2008). Effect of an argumentation-based course on teachers' disposition towards a science–IK curriculum. *International Journal of Environmental and Science Education*, 3(4), 159–177.
- Østergaard, E. (2017). Earth at rest: Aesthetic experience and students' grounding in science education. *Science & Education*, 26(5), 557–582.
- Regmi, J., & Fleming, M. (2012). Indigenous knowledge and science in a globalized age. *Cultural Studies of Science Education*, 7(2), 479–484.
- Shizha, E. (2013). Reclaiming our indigenous voices: The problem with postcolonial Sub-Saharan African school curriculum. *Journal of Indigenous Social Development*, 2(1), 1–18.
- Sjöström, J. (2018). Science teacher identity and eco-transformation of science education: comparing Western modernism with Confucianism and reflexive Bildung. *Cultural Studies of Science Education*, 13, 147–161.
- Sjöström, J., Rauch, F., & Eilks, I. (2015). Chemistry education for sustainability. In I. Eilks & A. Hofstein (Eds.), *Relevant chemistry education—From theory to practice* (pp. 163–184). Sense.
- Smith, T., Avraamidou, L., & Adams, J. D. (2022). Culturally relevant/responsive and sustaining pedagogies in science education: Theoretical perspectives and curriculum implications. *Cultural Studies of Science Education*, 17(3), 637–660.
- Underwood, J. B., & Mensah, F. M. (2018). An investigation of science teacher educators' perceptions of culturally relevant pedagogy. *Journal of Science Teacher Education*, 29(1), 46–64.
- Zidny, R., Sjöström, J., & Eilks, I. (2020). A multi-perspective reflection on how indigenous knowledge and related ideas can improve science education for sustainability. *Science & Education*, 29(1), 145–185.
- Zinyeka, G., Onwu, G. O., & Braun, M. (2016). A truth-based epistemological framework for supporting teachers in integrating indigenous knowledge into science teaching. *African Journal of Research in Mathematics, Science and Technology Education*, 20(3), 256–266.