South African Science Teachers' Strategies for Integrating Indigenous and Western Knowledges in Their Classes: Practical Lessons in Decolonisation

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Abstract

Framed within the broader discourse on decolonising African education, this article aims to contribute to the project of integrating indigenous and Western knowledges in southern African education. Following a participatory action research (PAR) cycle, a team of five South African science teachers and one German researcher explored whether and how indigenous knowledges (IK) could be integrated into the teachers' regular classes. The article focuses on the first two phases of the PAR cycle and discusses how challenges impeding knowledge integration were solved and how science lessons that integrated aspects of Western and indigenous knowledges were planned. While the South African science curriculum explicitly invites knowledge integration, it hardly contains any IK and there are no generally available teaching materials. Moreover, some of the participating teachers did not have IK. Yet, integration was possible, for example, through using the learners' communities as resources, a strategy that worked well in both primary and secondary grades. The article suggests that the very practice-oriented research process was also a process of intellectual empowerment and decolonisation. Calling on the agency of teachers, parents, community elders, traditional healers, and academics, the article argues for a bottom-up approach to knowledge integration and to decolonising education.

INTRODUCTION

While the struggle against the colonial legacy in African (higher) education gained new momentum during the student protests in South African universities in 2015, the calls for decolonising the education system are not new. For over two decades, scholars have criticised the dominance of so-called Western epistemologies in African education and advocated for the integration of indigenous knowledges (Abdi, 2006; Breidlid, 2013; Dei & Simmons, 2009; Nyamnjoh, 2016; Odora Hoppers, 2002; Odora Hoppers, Moja, & Mda, 1999). Framed in the broader discourse on decolonising African education, and building on the calls for knowledge integration, I discuss how five South African science teachers developed strategies to integrate indigenous and Western knowledges in their teaching. The purpose of the article is to contribute to the knowledge integration project by sharing, and reflecting on, practical experience. By *knowledge integration project* I mean the multi-levelled discourse that ranges from the abovementioned calls to indigenise education, to theorising how such an Africanisation might be realised (e.g., Yishak & Gumbo, 2012), to foregrounding cooperation between teachers and traditional healers (e.g., Hewson, Javu, & Holtman, 2009), or collaborating with communities to suggest suitable IK and integration strategies (e.g., Keane, 2006; Khupe, 2014). The final step completing the knowledge integration project would be its actual operationalisation, that is, teaching indigenous knowledges in education. Some of the few existing studies on this will be reviewed in the discussion part of the article. It is essential that all levels of the knowledge integration discourse be continued to enable educational practices that are embedded in theory and to prevent turning IK integration into a technical exercise. However, additionally, it is important to proceed to a practical exploration of knowledge integration, because decolonisation of education will not take place until educational practice actually changes. In the case of South Africa, the integration of indigenous knowledges into education has featured in the curriculum since 1997 and in the national Indigenous Knowledge Systems Policy since 2004. The newest version of the Grades 4–9 science curricula invited teachers to integrate IK (Department of Basic Education, DBE, 2011a, 2011b), but hardly any indigenous knowledges are specified in these curricula, nor are they part of the examinations. To date, (South) African teachers lack strategies to put into practice the existing theories and policies. What is therefore needed in addition to theoretical discourse, is (reflection on) practical experience about how the integration of knowledges can (or cannot) work in today's African education systems, thereby creating a foundation also for long-term educational transformation. By exploring some of the practical aspects of knowledge integration, the presented study aims to contribute to the practical level of the knowledge integration project.

Indigenous knowledges are here understood as ways of

> *knowing developed by local/indigenous peoples over generations as a result of sustained occupation of or attachment to a place . . . with the result that such occupancy allows peoples/communities to develop a perfect understanding of the relationship of their communities to their surrounding natural and social environments. (Dei & Asgharzadeh, 2006, p. 54)*

I use indigenous knowledges in plural to acknowledge the multitude of indigenous epistemologies. *Western knowledge*, on the other hand, refers to a single albeit diverse knowledge system that "originated in 16th-century Europe and together with industrial capitalism produced a specific kind of knowledge that is embodied in modern science" (Breidlid, 2013, p. 1). What separates indigenous and Western knowledges is not necessarily the knowledge as such—there can be both overlaps and

discrepancies. Rather, the difference can be found in the underlying worldviews or ontologies, and the resulting understandings of what knowledge is and how it is generated.[1]

The main research question was: "How can South African science teachers integrate indigenous and Western knowledges in their teaching?" However, given the many challenges our team identified, the question *if* integration was possible was implicitly asked as well. The questions where not explored in relation to a specific grade, but the focus was on all the grades that my coresearchers taught, namely, Grades 4–12, the actual integration of IK being tried out in Grades 5, 6, 7, 9, and 10.

While I am the sole author of the article and while the reflections in the discussion are mine, the research process and parts of the data analysis were a collaborative endeavour. Therefore, it is my pleasure and duty to acknowledge my coresearchers, Abongile Ludwane, Farasten Mashozhera, Margaret Speckman, Sipho Nuntsu, and Noluthando Mhlekwa. It is their experiences and our collaborative learning that I share in this article. I also make their contributions visible by using the pronoun, "we" whenever reporting on the collaborative aspects of the research.

(DE-)COLONISATION OF THE MIND AND OF EDUCATION

> *I think the black man is subjected to two forces in this county. He is first of all oppressed by an external world through institutionalised machinery, through laws that restrict him from doing certain things, through heavy work conditions, through poor pay, through very difficult living conditions, through poor education, these are all external to him, and secondly, and this we regard as the most important, the black man in himself has developed a certain state of alienation, he rejects himself, precisely because he attaches the meaning white to all that is good, in other words he associates good and he equates good with white. (Biko, 1978/1987, p. 100)*

This article is guided by calls against what Ngũgĩ wa Thiong'o (1981/1986) has called the *colonisation of the mind* and what Steve Biko in the above quote described as the second force of oppression. Relatedly, Frantz Fanon (1961/2004; 1951/2008), Aimé Cesaire (1955/2000), and Albert Memmi (1957/1990) have described the dehumanising effects of colonisation as a complete internalisation of the idea that everything connected with the white man and his culture is the desirable norm. With regard to education, this form of colonisation is connected to the truth and universality claims of Western scientific epistemology that imply a subjugation of indigenous knowledges (Breidlid, 2013) as well as equating education with European education (Abdi, 2005). More than two decades after the end of apartheid, African education has been characterised as continuing to be a "victim of a resilient colonial and colonising epistemology, which takes the form of science as ideology and hegemony" (Nyamnjoh, 2016, p. 69).

Many of those who call for the decolonisation of African education today are inspired by the idea of an African Renaissance, which, in turn finds a theoretical framework in the above-mentioned thinkers. Stating that the ideals of the African Renaissance are not new, Odora Hoppers et al. (1999) pointed out the need to acknowledge openly "the unsung heroes like Steve Biko and earlier and simultaneous struggles for African consciousness" (p. 234). The aim then and now was to become aware of, and overcome, intellectual colonisation as well as advancing an agenda of transformation and re-Africanisation (Ntuli, 1999). African indigenous knowledges are seen as foundation to reshape African curricula and education systems, thereby advancing the "cultural and socio-educational transformation of the African continent" (Higgs, 2016, p. 90), creating an African identity (van Wyk &

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[1] See Seehawer (2018) for a more elaborate discussion of the differences and similarities of knowledge generation in indigenous and Western epistemologies.

Higgs, 2012), and counteracting colonial influences. Breidlid and Botha (2015) described indigenous knowledges as "a counterhegemonic cultural force to that of colonialism" and, thus, "well-suited to exposing the Eurocentric assumptions inherent in conventional ideas about knowledge making, and formal education, in particular" (p. 319–320).

Biko's Black Consciousness movement was not about anti-whitism, but about enabling equal coexistence of black and white people. Relatedly, the African Renaissance neither calls for an "uncritical romantisation of the past" (Ngara, 2012, p. 134), nor for chasing out the former colonisers or their knowledge. Odora Hoppers et al. (1999, p. 237) declared that "whether we like it or not, we are of two worlds, both Western and African" and "the success of our renaissance will depend on how we position ourselves and reconcile the world views we have inherited." Likewise, Abdi (2005) did not propose a return to pre-colonial education, but a constructive integration of both indigenous and Western knowledges in education. Odora Hoppers (2002) cautioned that such an integration needs to go "beyond finding an aggregate position or middle ground upon which the two knowledge systems will then enter into an ahistorical dialogue" (p. 20). Instead, integration would include "power and knowledge critique and analysis of the hegemony of mainstream knowledges in terms of their silencing effects, paying attention to their nature, potentials, omissions and consequences" (Odora Hoppers, 2002, p. 20).

It is these calls and traditions of thinking that build the intellectual basis both for the content of the study that is discussed below (I will critique the extent to which we managed to follow these ideals) and the methodological approach that I now outline.

METHODOLOGY

Research Approach

The main approach to data generation in this study was participatory action research (PAR). The rationale for choosing PAR was twofold. First, the need to take serious the critique of so-called Western methodologies as inappropriate for research on indigenous epistemologies, and as causing harm to indigenous peoples and being an inherent part of the colonial endeavour (Chilisa, 2012; Smith, 1999). As an approach where research is done not *on*, but *with* people, PAR has been suggested as compatible with, and sensitive to, indigenous methodologies (Khupe 2014; Kovach, 2009). Second, including steps of reflection, planning, action, and evaluation/reflection, PAR bridges the gap between theory and practice and has the potential to achieve positive change in areas of concern for the people involved in the research. PAR was thus considered an appropriate approach to generating practical knowledge about the integration of indigenous and Western knowledges in the classroom.

Invited Participation and Research Team

The research team was composed mainly through voluntary sampling because the study required teachers with an interest in IK and in coresearching on this subject over a duration of several months. The science teachers from all public primary schools in Grahamstown, Eastern Cape, were invited to participate. Additionally, convenience sampling was used in that my host at Rhodes University invited secondary school science teachers whom he knew through his course lecturing at the university. The resulting research team consisted of three primary and two secondary school teachers, teaching all grades from Grade 4 to the final year. We perceived this breadth as an advantage because it allowed us to explore the integration of IK with different age groups.

My own role in the team was that of an initiator and facilitator of the study. While my coresearchers are South African or Zimbabwean nationals and have lived in the Eastern Cape for many years, I am

European and my longest stay on the Sub-Saharan continent did not exceed six months. Unlike my coresearchers, I am not a teacher but worked as an education adviser in an NGO before reentering academia. There are advantages to an outsider perspective. As coresearcher Margaret remarked, "you come from overseas and stir up people that are so comfortable watching things go wrong [in education]" (personal communication, October 16, 2015). While the careful study of decolonising and indigenous methodologies and ethics has been at the core of the presented study, my academic and epistemological socialisation took place in the Global North. There is a risk is that I too will become part of the "long and bumbled history of non-Indigenous peoples making moves to alleviate the impacts of colonisation" (Tuck & Yang, 2012, p. 3). Choosing PAR, employing careful participatory data analysis, and validation were some of the measures taken to counteract this risk. Moreover, my host provided cultural mentorship in terms of appropriate ways of gaining access and consent. For detailed critical reflection on ethics, participation, and the problematics of positionality in this study see Seehawer (2018).

Data Generation, Analysis, and Validity

The main data used in this article stems from 15 workshops of the research team between July and November 2015, and a joint presentation of this research. Additionally, I draw on the reflection notes that I took during the research, notes on personal conversations and semi-structured interviews with my coresearchers. The workshops took place on a weekly basis and lasted between 60 and 90 minutes. The research evolved as a collaborative learning process with the different stages of the action research cycle informing each other. Initially, only the main research question, "How can science teachers integrate indigenous and Western knowledges in their teaching?" was defined. All other questions and steps taken were developed collaboratively. I recorded the workshops, transcribed the recordings, and summarised the main outcomes of each workshop in a handout. The handouts served as basis for the following workshop as well as a form of validation and collective data analysis. My coresearchers had the chance to confirm, correct, or build on what they had said previously and we engaged in meaning making of, and reflection on, our findings. In addition, we jointly revised our main findings at the end of the research period. Other means of collaborative data validation were copresenting our findings to an interested audience and coauthoring a booklet for other teachers (Seehawer et al., 2015), which created a common narrative of our research journey. In addition to the above mentioned data sources, I observed my coresearchers teaching and conducted semi-structured focus groups with some of their learners. This data is not utilised in this article, but contributes to validity through triangulation. After returning home from the fieldwork, I continued to analyse the data by myself, seeking out my coresearchers' participation from a distance. For example, I sent them all publications resulting from the study, including this article, inviting them to check quotes and provide feedback or input.

The Action Research Process

Our study followed an action research cycle of reflection or mapping the current situation, planning, action, and reflection/evaluation. In the reflection phase (Workshops 1–6), we discussed questions such as "What are indigenous knowledges?" "What is the relevance of IK?" and "Why integrate indigenous and Western knowledge in science education?" We mapped challenges regarding (the teaching of) IK and brainstormed possible solutions. In the planning phase (Workshops 7–12), we discussed different strategies of integrating IK and possible teaching methods. Each teacher planned a lesson or curriculum unit that integrated IK with the regular curriculum content. Action, that is, the teaching of the planned lessons, took place between Workshops 12 and 14, while Workshops 13–15 were devoted to evaluation.

This article focuses on the first two research phases, namely, reflection and planning, although reflections and findings from the latter two phases are included wherever applicable. Aspects of the

latter two research phases, action and evaluation, will be discussed in more detail in a forthcoming publication (Seehawer & Breidlid, 2018). There are findings at each stage of the action research cycle that inform the next phase and make process and findings partly inseparable. For example, planning the lessons was a part of the research process but also an important finding, contributing to answering the question how teachers can integrate IK. I first present and discuss these *process findings*, before situating and discussing the findings in the framework of decolonisation.

RATIONALE: WHY INTEGRATE INDIGENOUS KNOWLEDGES?

The main research question was *how* science teachers can integrate indigenous and Western knowledges. However, this question depends on *why* these knowledges are sought to be integrated. Method and approach might differ depending on whether IK is understood as a tool to facilitate learners' access to "real" science or whether learning IK is regarded as an end in itself. As discussed above, IK integration is here understood as a prerequisite to decolonise and Africanise education. However, my coresearchers requested to discuss the relevance of indigenous knowledges before developing integration strategies, to enable them to "emphasise to learners the importance to know about [IK]" (Noluthando, Workshop 5, May 19, 2015). This is in line with Òtúlàjà, Cameron, and Msimanga (2011) who stressed the importance for teachers to become clear about their own thinking regarding IK to prevent further misuse or devaluation of these knowledges. These are the reasons our team identified, all of which are also discussed in scholarly literature:

- *Decolonisation. To decolonise people's minds and advocate against the perception of IK as inferior (Abdi, 2006; Breidlid & Botha, 2015; Dei & Asgharzadeh, 2006; Dei & Simmons, 2009; Ngara, 2012).*

- *Relevance. Making classroom science more relevant through:*

  o *Teaching knowledge that is relevant for learners' daily lives (Keane & Malcolm, 2003)*

  o *Using IK as a tool to make Western science more accessible, moving from the known to the unknown (Mawere, 2015).*

- *Widening perspectives. To offer alternatives and broaden horizons: There are several options in the world to know or do the same thing in different ways, "two-eyed seeing" (Aikenhead & Elliott, 2010, p. 326).*

- *Sustainable development. To promote local solutions and a healthy, sustainable lifestyle, environmental protection (Breidlid, 2013; Glasson, Mhango, Phiri, & Lanier, 2010).*

- *Cultural identity. To connect learners with their culture and bring back the role of parents, community, and elders into education (Khupe, 2014; Mawere, 2015; Msimanga & Shiza, 2014).*

The teachers' personal motives to integrate indigenous knowledges were visible in the research process. For primary school teacher, Farasten, integrating IK would make science classes relevant to his learners' life realities. His concerns were environmental sustainability and appreciation of nature, and he planned his lessons accordingly. Margaret thought that "the science that we teach" is defined "by people who have never taken the learners' [indigenous] knowledge into consideration," which turns classroom science into "something being imposed on them to a certain extent" (Workshop 4, August 12, 2015). Relatedly, Sipho integrated IK to build on his learners' prior [indigenous] knowledge,

his strategy for making the science class "very attractive" for his Grade 6 learners (personal communication, October 20, 2015). High school teacher, Abongile, was interested in localising the curriculum, wishing her learners to value what is "in their own backyards," instead of associating "good things" only with "developed" urban areas such as Johannesburg or Cape Town (research presentation, November 11, 2015). Noluthando wanted to enable her Grade 10 learners to use indigenous practices to clean "dam or river water. So even if they don't use this water for consumption, [learners can use it] maybe for washing purposes." This would be helpful "in terms of our water scarcity, because that dam doesn't go dry and it's there in the location [where the learners live]" (Workshop 14, November 4, 2015). She let her learners apply both indigenous and chemical cleaning processes and had them test the water samples afterwards, to compare the results. Thus, in my coresearchers' case, IK integration mainly evolved around aspects of recognising and engaging learners' lived realities and their indigenous knowledges, a motivation to decolonise and localise the curriculum, and developing local, sustainable solutions.

Building on Òtúlàjà et al. (2011), I propose that becoming aware of one's own motivation is a useful foundation at the start of the planning process because it gave the teachers ownership over their teaching of IK. I argue that all of the reasons listed above can contribute to the overarching aim of decolonising education, because all of them emphasised different nuances of IK. Understanding IK as a tool to make Western science more accessible might be problematic in this regard because it could insinuate the continuation of skewed power relations between Western and indigenous knowledges. However, in the understanding of African Renaissance outlined above, decolonisation does not mean throwing overboard Western knowledge. While African indigenous epistemologies are at the heart of the Renaissance project, the aim is a constructive integration of different epistemologies in education. Thus, unless IK is perceived as a means to an end only, there is no problem with drawing on IK to help learners understand Western science. What is important, however, is an awareness of our aims when teaching IK (or any knowledge for that matter). Integrating IK just for the sake of integration (as an unspecified policy and curriculum requirement) becomes a meaningless technical exercise.

WHAT HINDERS TEACHERS TO INTEGRATE IK? IDENTIFYING AND OVERCOMING CHALLENGES

Another aspect my coresearchers wished to discuss in the reflection phase, and which they frequently returned to, were the challenges regarding (the teaching of) indigenous knowledges. This is unsurprising, given the seemingly impossible task: how can teachers be expected to integrate IK, if teacher education does not prepare them to do so, if there are no teaching recourses available, if indigenous knowledges are hardly specified in the curriculum and if teachers do not necessarily have IK themselves?! The challenges that my coresearchers identified were of both practical and ideological nature. Finding solutions was an ongoing process that did not only contribute to answering the question, how teachers can integrate IK, but also whether it was possible at all. I am neither suggesting that there are no other challenges nor that ours were the best solutions, but wish to offer our team's experience as a basis for further exploration and debate.

Another explanation for why our discussions frequently returned to the challenges regarding indigenous knowledges might be found in the notion of intellectual colonisation outlined above, which neatly conforms to the common perception of indigenous knowledges as inferior knowledges pointed out by my coresearchers. For example, "When you go to an herbalist, you feel you go to a lesser qualified medical practitioner," Abongile explained (Workshop 4, August 12, 2015). Indeed, the internalised idea of indigenous knowledges as inferior permeates all challenges discussed in the following. Below, I will argue that while working on overcoming challenges that prevented the integration of IK and thereby aiming to contribute to decolonising education on a practical level, a process of theoretical or intellectual decolonisation took place among our research team.

Challenge 1: Curriculum and Structure of Education System Make It Hard to Integrate IK

- *Hardly any (guidance on) IK in the science curriculum*

- *Teachers are under pressure to teach to the test*

The most recent South African curriculum lists "valuing indigenous knowledge systems" as one of seven principles of the education system (DBE, 2011a, 2011b, 2011c, p. 5). This could be read as an acknowledgement of the African Renaissance's decolonisation calls. However, it is unclear how this principle actually features in education. The Grades 4–9 science curricula contain a statement about teachers having "the freedom to expand concepts and to design and organise learning experiences according to their own local circumstances" by selecting examples of IK that "reflect different South African cultural groupings" (DBE, 2011a, p. 14; 2011b, p. 16). The taught IK must not depart from the curriculum, but should "link directly to specific content" (DBE, 2011a, p. 14; 2011b, p. 16). The Grades 10–12 science curriculum mentions that "all scientific and technological knowledge, including Indigenous Knowledge Systems . . . is used to address challenges facing society," whereby some indigenous concepts "lend themselves to explanations using the scientific methods while other concepts do not; this is still knowledge however" (DBE, 2011c, p. 8). The curriculum thus opens up for different epistemologies, but there is no specification about how these should be integrated. In all grades, the science curricula contain few, if any, explicit mentions of IK. Thus, as Sipho repeatedly remarked, the integration of IK is up to the teacher's creativity, which is possibly an advantage for some, but certainly a challenge for many in a hectic everyday teaching life. Time to cover the curriculum is scarce because teachers are under constant pressure to prepare their learners for the examinations that terminate each of the four terms of the school year and that do not comprise IK.

Thus, what we needed was a strategy that enabled the integration of indigenous knowledges without IK necessarily being mentioned in the curriculum, without departing from the curriculum, and without losing teaching time. This proved easier than my coresearchers expected. "The topics we are teaching are Western science. The designers of the curriculum are Western oriented. IK was never considered," Farasten elaborated, indirectly referring to the colonial subjugation of indigenous knowledges, "so you find that for some topics it is difficult to integrate IK. Sometimes, when I am teaching electricity or photosynthesis, I really ask myself, which IK can I integrate to make this relevant [for my learners' lived realities]?" (Workshop 4, August 12, 2015). Nevertheless, my coresearchers did not have difficulties to identify topics in the curriculum that invited the integration of IK. I will elaborate our approach below.

Challenge 2: Lack of (Access to) Indigenous Knowledges

- *There are no generally available teaching materials*

- *Teachers do not have (the right) IK*

- *Learners have different IK, which should we teach?*

Abongile, a young science teacher in her first year of teaching, grew up in an urban township without IK being part of her upbringing. She wondered "how teachers, from the upcoming generation like myself with so limited IK, can teach and advocate for indigenous knowledges?" (Workshop 4, August 12, 2015). Efforts to document and make available relevant IK for teachers are "still in its very formative stages" (Msimanga & Shiza, 2014, p. 143) and to date, science teachers receive "Western education [a] type of education that regards IK as inferior" (Farasten, Workshop 4, August 12, 2015). Some teachers, such as my coresearchers Sipho and Margaret, have much IK—because of personal interest or growing up in families in which indigenous knowledges were valued and passed on. Others, such as Abongile, do not. Farasten's IK stems from his home country, Zimbabwe, and might differ from Eastern

Cape IK. Moreover, South African classrooms are multicultural. Many teachers may find themselves in Abongile's situation—Xhosa, Shona, and Zulu learners in the same classroom, all of them entering school with different backgrounds and different IK. Whose IK should Abongile teach these learners? As stated above, the curriculum suggests including IK examples from different South African cultural groupings. But to do so, even Sipho's or Margaret's rich indigenous knowledge would not have been sufficient.

Inspired by previous research, we compiled strategies that neither require teachers to have the actual IK themselves nor to rely on textbooks and teaching resources:

- *Give an assignment to the learners to inquire about specific indigenous knowledges or practices with their families and communities. Discuss the knowledge in class (Keane, 2006; Khupe, 2014; Schabort, 2011).*

- *Collaborate with IK holders such as community elders, herbalists, or traditional healers. Possibly invite them to the classroom (Hewson et al., 2009).*

- *Take the learners to places (e.g., nature, museum) where they can learn about indigenous knowledges (Cocks, Alexander, & Dold, 2012; Khupe 2014).*

An important realisation was that if we do not have IK ourselves, we could use the learners' families and communities or other knowledgeable persons as resources—a measure that supports the idea of bringing back community into education. From the teacher, it requires a willingness to give up the monopoly on knowledge and, rather, to assume the role of a facilitator of classroom discussion. This is in line with Odora Hopper's (2002) suggestion that integration should be critical engagement that also addresses power imbalances between epistemologies. Naturally, the level of discussion and reflection will vary according to the age of the learners, but our experience showed that, already, Grade 6 learners could discuss the advantages and disadvantages of indigenous and Western sun protection practices, which might be a start of such critical engagement.

My coresearchers chose to focus on the first of the above strategies. Except in one case where Grade 7 learners had not done their homework, arguing they had no one at home to inquire with, this strategy worked well with all involved age groups. For example, Farasten sent his Grade 5 learners to "find out from home the various uses of soils" and was impressed by the breadth of examples they reported in class: "I was so surprised when they were presenting, really, you could write a good thesis on that!" (research presentation, November 11, 2015). Similarly, Noluthando's Grade 10 learners, who had been asked to inquire about water purification practices, presented a large variety of suggestions. This strategy ensures the integration of IK of all cultural groupings present in the classroom, which links to the aims of building a bridge between school science and home knowledge and making science teaching relevant to learners' daily lives. It does not, however, include examples from cultures that are not present, which is what the curriculum suggests. Here again, the question is with what aim IK should be included and to choose a strategy accordingly. Not all of the learners' examples were IK. When asked about different ways of protecting against the sun, Sipho's students talked about sunscreen as well applying a paste mixed from water and clay soil to the skin. We did not regard this as problematic given that the aim was not to integrate pure IK, but to be inclusive of all knowledges the learners brought to class. In Sipho's case, he put the epistemologically different sun protection practices in context for his learners.

Challenge 3: A Clash Between Christianity and the Spiritual Aspects of IK?

Abongile's interest in indigenous knowledges had motivated her to participate in our study. However, as a faithful Born-Again Christian, she was concerned about the common perception of IK being "somehow connected to the spiritual site of life" and feared that persons engaging with IK might be regarded as "less of a Christian" (Workshop 4, December 8, 2015).

Indeed, some South African churches discourage the use of indigenous knowledges and practices, whereas others embrace them as a part of culture. Scholars take different standpoints regarding the role of spirituality in Southern African IK.[2] For example, Òtúlàjà et al. (2011) emphasised that "only some aspects of IK are spiritually rooted while . . . perhaps the largest part, has to do with the science of day-to-day experience" (p. 698). Others such as Breidlid (2013) or Msimanga and Shiza (2014) regard spirituality as a central aspect of IK. According to Breidlid (2013), spirituality differentiates IK from Western epistemology, the latter based on the Cartesian divide that separates spirituality and knowledge.

Given these different standpoints, here more than for the other challenges, an individual rather than a general solution was viable. For my other four coresearchers, all of whom are avowed Christians, using IK did not conflict with their religion. Margaret elaborated: "I feel that God has given us the freedom to use everything he has created and has put on earth for us. There is only a misunderstanding when we undermine Him as our creator" (Workshop 6, August 26, 2015) She said the problem was not utilising herbs for healing purposes, but that the same plants could be misused for witchcraft; a temptation that, as Farasten pointed out, would affect "people with a weak faith, " but not "the mature Christian" (Workshop 13, October 28, 2015). With three of my coresearchers being Seventh-day Adventists, we consulted with an Adventist pastor. He did not see anything wrong with the use of herbs either, but found it decisive to whom the healing process was attributed: whether to the ancestors or to God who speaks through the herbs (personal communication, August 2015). Abongile explained that her coresearchers' and the pastor's clarifications dispelled her concerns.

PLANNING THE INTEGRATION OF INDIGENOUS KNOWLEDGES

Building on our learnings from the reflection phase of the study, we planned the integration of indigenous and Western knowledges in the following steps:

Choosing a Suitable Curriculum Unit

As elaborated above, we required a strategy that allowed the integration of IK without losing teaching time or departing from the curriculum. Pressure on my coresearchers was even higher because the school year had proceeded to the final term, which is dominated by the annual examinations starting around a month into the term. We thus decided that the lessons had to be held during the first two weeks of the term. This narrowed down the choice of curriculum topics for the integration of IK considerably. With the exception of the Grade 7 curriculum, none of the Grades 4–12 science curricula contains IK in Term 4. Nevertheless, all five coresearchers identified suitable topics for five different grades without difficulty. For example, with her Grade 10 class, Noluthando had to cover the Chemistry of the Hydrosphere (DBE, 2011c, p. 60). She thought this topic invited the integration of IK because learners have to study the ecology of rivers and learn about water purification. Abongile found Mining of Mineral Resources in Grade 9 (DBE, 2011b, p. 80) a suitable subject because she could integrate IK

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[2] The debate is ongoing; for example, at the 3rd conference of the African Association for the Study of Indigenous Knoweldge Systems (AASIKS) at the University of the Witwatersrand (WITS) in November 2017.

about limestone mining in Grahamstown, focusing on the local anchorage of her topic (personal communication, October 2, 2015).

Reflecting on What Kind of IK to Integrate Into the Chosen Topic

Apart from the mentioned exception of Grade 7, the chosen curriculum topics did not include IK in the set syllabus, which left the decision of which IK to integrate to us. As my coresearchers did not necessarily have IK on the chosen topic, our approach was to decide what the integrated IK should be about rather than listing specific knowledge. For example, in her lesson plan, Noluthando noted that she would integrate IK on water purification but did not determine specific indigenous water purification methods. This strategy gave learners the chance to contribute with all practices they gathered from their families rather than limiting their participation, while it enabled Noluthando to integrate IK without having to be aware of all indigenous water purification methods. She just needed to assume that IK about water purification existed.

Identifying the Purpose of Integrating IK in the Respective Lesson: The Possible Benefits Learners Should Gain From the Lesson

I argued above for the importance of being clear about one's motivation to integrate IK to avoid turning it into a technical exercise. Thus, in this step of planning, the teachers reflected on what they wished the learners to take away from the lessons. In other words, we answered the why-question for each respective curriculum unit and did so by choosing from the list of reasons we had generated earlier (see above).[3] For example, in his lesson on sun protection, Sipho aimed to connect his Grade 6 learners with their culture and bring back the role of parents, community, and elders into education. Moreover, he wished to broaden his learners' perspectives by discussing both indigenous and Western sun protection measures. He said integrating knowledges would give learners "a wide knowledge. They must not only concentrate on the Western knowledge, they can also know: oh, in the years before, people were using these practices. Even today, they can choose which way to go" (Workshop 11, September 30, 2015). Finally, Sipho thought that including indigenous practices from learner's everyday lives would build a bridge between home knowledge and classroom science and make his teaching more relevant for his learners.

Choosing Suitable Teaching and Learning Methods

Shava, O'Donoghue, and Ngcoza (2015) suggested a number of strategies for the teaching and learning of indigenous knowledges and kindly permitted our team to pilot them. The methods take into account that IK "is about holistic, context-based, integrated people-environment interrelationships" and can, therefore, best be acquired in "practice-oriented" activities (p. 28).

- *Observations: Many indigenous practices are embedded in everyday practices and can be learned through observation or,*

- *through participating in these activities, namely, experiential learning/learning by doing.*

- *Investigations: About indigenous practices with the learners' communities.*

- *Deliberations: Classroom discussions on (particular aspects of) IK can reveal the wealth of IK and be a process of "learning from each other" (p. 27).*

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[3] The same list of aims also served as evaluation criteria in the last research phase.

- *Storytelling: As a traditional way of passing on IK can also be practised in the classroom.*

These teaching methods harmonised with the above list of IK integration strategies we had compiled, especially, as Shava et al. (2015) suggested inviting elders or other IK holders to the classroom to share their knowledge or demonstrate indigenous practices. My coresearchers mostly chose investigations in combination with classroom discussions about the inquired knowledge.

Examples of Lessons or Curriculum Units

Below, in Tables 1 and 2, are two examples of how we planned the lessons or curriculum units. The upper part of each table (underlined grey) is copied from the respective science curricula without changes. The bottom part indicates the indigenous knowledges that the teacher aimed to integrate with the given curriculum content, the teaching methods, the hoped benefits for the learners, and the mode of integration, that is, a specification of how the teacher planned to integrate IK and curriculum knowledge in the lessons. The reason for dividing the table between curriculum content and IK was not to present the two knowledges as necessarily separate or oppositional, but to ensure that the curriculum was followed—which was important to my coresearchers. "I must make sure that whatever indigenous knowledge I bring in, it's in line with what the curriculum requires me to teach," Farasten said (Workshop 10, September 23, 2015). As mentioned above, time is scarce to cover the obligatory content and it is an official requirement that IK must be directly linked to specific curriculum content. Our tables thus aimed to make transparent both that the curriculum was followed and that curricular and indigenous knowledge matched and complemented each other.

Table 1: Lesson plan, Grade 5, Term 4

Grade 5 – Term 4 – The Surface of the Earth – 2 ½ weeks (8 ¾ hours)

Information from CAPS	Suggested activities
CONTENT & CONCEPTS **Rocks** • the surface of the Earth is called crust, and consists of rocks (even under the oceans), and soil • soil, air, water and sunlight support life on Earth Soil comes from rocks • the land is made up of rocks, subsoil and top soil • soil supports life on Earth • top soil lies on the surface -- top soil is formed when rocks break into small grains over time **Soil types** • soil is usually a mixture of different types of soil grains in different proportions -- sandy soil – has a high proportion of course sand grains -- clayey soil – has a high proportion of fine grains of clay -- loamy soil – has a mixture of sand, clay and other soil grains. Loamy soil also contains humus (decomposed compost) • the soil also has air, water, remains of dead organisms and very small living organisms in it • soil forms very slowly in nature – once topsoil is lost, it cannot be replaced, and thus we need to conserve it	• Investigating – different soil types - writing and drawing about the colour, smell and texture of the soil - measuring and recording on a table how much water different soils can hold - using the results to draw bar graphs and / or Investigating – growing seedlings in different soil types (Integrating with Life & Living) - measuring, recording and comparing the heights of the seedlings - using the results to draw bar graphs [This can be used as a possible project]

Indigenous Knowledges to integrate:
• how to make soil fertile (before there was fertilizer);
• What to plant into which soil and how, fruit sequencing;
• Other IK about soil (e.g. indigenous usages of soil such as for sun protection or paint of houses)

Activities & teaching strategies:
• **Investigations** at homes, with communities, elder people to access local/indigenous knowledge;
• **Classroom discussion** of the knowledge the learners brought (relating this knowledge to the scientific experiments and observations that the learners make in the classroom, e.g. planting a bean in different soils, etc. See Caps above); discussing indigenous vs chemical ways of fertilizing soil

Mode of integration:
IK will be integrated with Western science in all the lesson, to show that the knowledge can complement each other and that there is no contradiction between the knowledge

Possible benefit for the learners:
• Making use of, and valuing, locally available resources (soil and crops that grow at home)
• Making learning more relevant and directly applicable to learners' daily lives
• Building a bridge between classroom science and "home knowledge" (discovering the science in the local knowledge)
• Bringing parents and community back into education
• Offering alternatives to Western knowledge (e.g. how to make soil fertile)

Table 2: Lesson plan, Grade 10, Term 4

Grade 10 – Term 4 – The hydrosphere (Its composition and interaction with other global systems). **8 hours**			
Information from CAPS			
Content, Concepts & Skills	**Practical Activities**	**Resource material**	**Guidelines for Teachers**
The hydrosphere consists of the earth's water. It is found as liquid water (both surface and underground), ice (polar ice, icebergs, and ice in frozen soil layers called permafrost), and water vapour in the atmosphere.			The focus of this section should not be the chemical equations or any rote learning, but should encourage application, interpretation, and environmental impact.
- Identify the hydrosphere and give an overview of its interaction with the atmosphere, the lithosphere and the biosphere. Water moves through: air (atmosphere) rocks and soil (lithosphere) plants and animals biosphere) dissolving and depositing, cooling and warming	Study the ecology of the dams built to provide water for communities. For this activity learners will have to rely on interviews with the people who have lived in the area under investigation for many years or rely on literature about their areas -Study the ecology of rivers in your area - Study the ecology of the dams built to provide water for communities	Use TETRA-test strips to test for water (buy from pet shop for fish tanks). Silver nitrate, microscope or magnifying glass, filter paper and funnel.	The hydrosphere is not a global cycle. The emphasis should be on the CHEMISTRY of the hydrosphere. This topic can be given as a **project** to save teaching time.
- Explain how the building of dams affect the lives of the people and the ecology in the region	Investigate how the building of dams has changed the ecology of rivers and the livelihood of people in the areas around them by applying the science you learnt this year		

Indigenous Knowledges to integrate:
- indigenous methods of water purification and protection of the environment (i.e. how did/do people protect water where there were/are no tabs)

Activities & teaching strategies:
- **Investigation** at homes, with communities, elder people to access local/indigenous knowledges;
- **Classroom discussion**: of the knowledge that the learners brought to class; linking and comparing it with classroom science ➔ "interaction" between IK and scientific knowledge; discussing indigenous/traditional vs. scientific methods of water purification: what are advantages and disadvantages (e.g. in terms of environmental protection)

Mode of integration:
Continuous integration from one lesson to the other

Possible benefit for the learners:
- Practical applicability of knowledge (i.e. water purification when technology is not available)
- Environmental awareness
- Awareness that there are different knowledges/different ways of doing things which each have advantages and disadvantages
- Open-mindedness

DE-COMPLICATING AND RE-COMPLICATING KNOWLEDGE INTEGRATION

Integrating Indigenous Knowledges Is Easy—for Decolonised Minds

After spending much time discussing the challenges that seemingly precluded integrating indigenous knowledges, doing it was surprisingly easy. Reviewing these challenges at the end of the research period, we realised that none of them had proven to be a serious obstacle. Besides developing practical strategies, the most important prerequisite to enable knowledge integration may have been a process of overcoming an internalised idea of IK (integration) as necessarily problematic or difficult. In contrast to tangible integration strategies, this process, which I argue was a process of learning, empowerment, and intellectual decolonisation, happened inwardly. It is, therefore, hard to capture in explicit statements but might best be visible through the team's gradual shift away from connecting indigenous knowledges with challenge. Instead, there were realisations such as that despite its Western nature it was easy to identify suitable topics in the curriculum, or that it was possible use learners' families as resources if the teacher lacked IK. The focus shifted to constructive planning and, eventually, teaching of lessons. Some of the challenges my coresearchers had identified initially, such as the problem of some IK being threatened by extinction, caused amusement during the evaluation phase. Not, because this should not to be taken seriously, but because of having recognised teachers' agency to counteract this problem through their own teaching: "I think that is the main reason why we are here," Farasten remarked, "for empowerment. We search for information, we implement, we share, so that we as educators become recourse persons" (Workshop 13, October 28, 2015). Fanon (2004) wrote about intellectual decolonisation that the stage of assimilation to the coloniser's culture is followed by a process of awakening, in which the colonised's "conviction is shaken" (p. 159) and, finally, a combat stage: "Instead of letting the peoples' lethargy prevail," the formerly colonised intellectual will turn "into a galvanizer of the people" (p. 159). Some of this activism, I argue, is noticeable in Farasten's above statement and in Margaret's repeated wish to raise awareness about "the fact that the curriculum designers don't mention indigenous knowledge" and argue for its integration, for example by having the local newspaper report on our research or publishing "something together as a team" (Workshop 8, September 9, 2015).

The final step of the knowledge integration project, the actual integration of indigenous and Western knowledges in the classroom, might not typically be perceived as the task of academics but, rather, as the responsibility of policy makers, education authorities, and teachers. However, I argue that academia and research have an important role to play not just at the theoretical levels of knowledge integration project, but on the very practical levels as well. Through collaborating and coresearching with teachers, learners, parents, communities, elders, traditional healers, teacher educators, or local authorities, integration strategies can be explored and solutions to challenges be developed. For example, Schabort (2011) worked together with a science teacher in KwaZulu-Natal to implement a curriculum unit on HIV/AIDS that integrated local and scientific knowledge. The Inkcubeko Nendalo project took urban Eastern Cape learners on forest excursions and provided classroom lessons on biodiversity IK (Cocks et al., 2012). In the Science and Indigenous Knowledge Systems Project (SIKSP), Western Cape science and mathematics teachers participated in argumentation workshops aiming to equip them to integrate IK (Hewson & Ogunniyi, 2011; Nhalevilo & Ogunniyi, 2014). Nkopodi and Mosimege (2009) found that the popular indigenous children's game of *morabaraba* can be used in the classroom to promote the learning of mathematics. Alternative to initiating own projects, researchers can discuss and theorise existing IK integration projects, thereby making them more widely available to relevant audiences, and provide examples to learn from (e.g., Burford, Kissmann, Rosado-May, Dzul, & Harder, 2012; Klein, 2011). Lastly, academics can continue to advocate with policy makers to make IK a more visible pillar of (South) African education. Thereby, studies like the above-mentioned can serve as policy input or examples of how to operationalise the existing policies.

What the reviewed studies—ours hoping to be one of them—have in common, is a constructive approach to knowledge integration that focuses on practical exploration, rather than on deficit discourses. They show that an integration of IK and Western knowledge in education is possible and appreciated by the learners and that different stakeholders such as teachers and traditional healers are willing to engage in (hitherto unusual) partnerships to make this happen. With regard to decolonisation, these studies can contribute to overcoming internalised notions of IK being inferior and pave the way to the critical engagement with different epistemologies within education that proponents of the African Renaissance are calling for.

Integrating Indigenous Knowledges Remains Difficult

On another level, knowledge integration is highly complex with many unanswered questions attached to it. As argued at the outset, the theoretical debates of the multilayered knowledge integration project need to be continued. If decolonisation and Africanisation of education are to be taken seriously, knowledge integration must go beyond integrating indigenous content knowledge as was piloted in our study and address the general structure and physical setting of education. Contributing to these debates exceeds the purpose of the present article, but based on our research experience I raise some questions that require further reflection and exploration. For example, is the classroom the right arena to teach IK? Pre-colonial African education has been characterised as informal, situated, orally transmitted, or practical learning (Abdi, 2005; Ocitti, 1994), whereas school as a formal institution was introduced by missionaries and colonisers. While African Renaissance is not about returning to pre-colonial times, the question is whether the formal classroom as a Western setup is the right space to learn indigenous knowledges. "When you are learning about soil, it's an outdoor lesson," Farasten said, "so I went outside [with the learners], I went to the garden. . . . It doesn't really work well to conceptualise this inside the classroom" (Workshop 14, November 4, 2015). The question of suitable teaching methods was part of our study but needs further exploration together with the question whether written exams are appropriate to test knowledge that is traditionally transmitted orally or acquired through practical activity. Further, there might be a clash between the holistic nature of IK, versus compartmentalised school subjects, that became visible in some of our pilot lessons.

KNOWLEDGE INTEGRATION AS BOTTOM UP-DECOLONISATION

With regard to decolonisation, the shortcomings of the presented study are obvious. We integrated African indigenous knowledges into a Western curriculum, into Western subjects that were being taught within a Western-type setting. Thus, my self-critique is that IK can still be regarded as other(ed) epistemologies that we integrated into an imposed norm. On the other hand, the question is whether it makes sense to wait for substantial changes in the education system before starting to integrate indigenous knowledges. In the case of South Africa, the postapartheid era has seen several education reforms, all of which brought some change, but none of which adequately addressed the decolonisation of the education system. Despite acknowledging indigenous knowledges as one of seven principles of education, IK has, to date, remained a mostly rhetoric add-on that leaves teachers wondering about how to proceed. Therefore, while advocacy and lobbying with policy makers and politicians remain central, this article calls on the agency of teachers, parents, students, community elders, teacher educators, traditional healers, and academics. Rather than waiting for top-down changes in the education system, it might be more realistic and promising to implement the bottom-up changes that these individuals and groups are able to do—which is what I mean by *bottom-up decolonisation*. In the words of Farasten:

> *The groundwork, you know, it's starting with us, the teachers. Are we convinced of the importance of indigenous knowledge? The universities where teachers are trained, are they convinced? If they are, what are they doing about it? Are we talking of something, which is going to take hundreds of years to become a reality? But even if it does, it must have a beginning somewhere. Remember, I was saying if we don't have [indigenous] knowledge, we should search for this knowledge, so that we have it, we own it. Then we apply it in our context. It's important. Otherwise, if we say let's have an [indigenous] curriculum, it's going to take years; maybe it won't happen. So it's something personalised, starting with me, the teacher. The learners whom we are going to promote, they must have this mind-set that indigenous knowledge is important, so when they come into university with this mind-set, maybe something will happen.[4] (Workshop 5, August 19, 2015)*

Teachers, parents, students, elders, traditional healers, and academics cannot change the education system from the top, but they can initiate decolonisation bottom-up. For example, teachers can integrate IK into their teaching, inspire colleagues to do so too, and nurture an interest among their learners. Student teachers can write their theses on IK, academics can initiate and research integration projects, teacher educators can make IK a part of teacher training. All of this is happening already in a small way, one example of which is my host's collaboration with a Xhosa elder who teaches science students at Rhodes University about the making of the traditional beer, *umqombothi* (Ngcoza, 2018). It is this kind of bottom-up example that mainstream educational discourses could learn from.

Two things are necessary: firstly, de-complicating IK integration and creating an empowering discourse that focuses on what teachers, teacher educators, and others can do, rather than on what they cannot do—in short, bottom-up decolonisation. Second, re-complicating the debates by taking seriously the unsolved questions on knowledge integration and decolonisation. Indigenous knowledges are about survival, identity, and flourishing of the people holding these knowledges, the practical nature of IK calling for a hands-on learning-by-doing approach. Indigenous survival, identity, and flourishing in present day African education systems might require adopting a bottom-up approach to decolonisation—while continuing to advocate for top-down changes.

ACKNOWLEDGEMENTS

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[4] With Farasten's permission, I have shortened his originally longer statement, making sure to maintain his own words.

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