ARTICLE

RESEARCHING INDIGENOUS SCIENCE KNOWLEDGE INTEGRATION IN FORMAL EDUCATION: INTERPRETING SOME PERSPECTIVES FROM THE FIELD

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ABSTRACT

This article is based on research, the goal of which was to explore with participants in a selected community in Mpumalanga (South Africa) possibilities that they foresaw for drawing on their ancestral knowledge and Indigenous approaches to knowing in the process of (beginning) science teaching. Thirty participants—15 elders and 15 primary school teachers—were interviewed. The teachers were found to have a variety of perspectives on the status of Indigenous science in formal education. Nevertheless, all the teachers in the study agreed that if Indigenous knowledge and ways of knowing were to become integrated in the curriculum and implemented, then elders should be at the forefront. Elders' perspectives were also elicited. Some felt that it was important to create a different teaching and learning space where the validation of Indigenous knowledge could safely occur.

Keywords: Indigenous knowledge; Indigenous science; knowledge integration; spirituality; sustainable development; validation of knowing

UNISA university of south africa

International Journal of Educational Development in Africa
https://upjournals.co.za/index.php/IJEDA
Volume 3 | Number 1 | 2016 | #2696 | 14 pages

http://doi.org/10.25159/2312-3540/2696
Print ISSN 2312-3540

INTRODUCTION

Scholars such as Adefarakan (2011), Adyanga (2014a, 2014b), Dei (2008, 2011), Dei, Hall, and Rosenberg (2000), Knudson (2015), McIntyre-Mills (2014), and Maune (2017) have argued that without the inclusion of Indigenous knowledge systems (IKS) in the curricula of educational institutions, the contributions of the ways of the Indigenous to explore valued options for social and economic development become sidelined in our social discourses across the globe. This concern stems from the realisation that IKS, which includes knowledge developments and communally oriented processes for knowledge construction developed by Indigenous people (cf. Goduka 2012; Gumbo 2012; Romm 2017; Van Wyk 2002; Wilson 2001), has since colonial encounters been systematically uprooted and sidelined from the formal education curriculum.[1] However, many of the debates in academia to date have become engrossed by the definition of Indigenous knowledge (IK) and heated comparisons between IK and Western scientific paradigms of thought, as if IK lacks scientific validity (Tengo et al. 2014; Van Damme and Neluvhalani 2004; Van Sertima 1983).

In this article, we use the term "knowledge" broadly to refer to the different ways that different individuals and societies construct and interpret realities based on their lived experiences, history, mythology and/or belief systems. This conceptualisation of knowledge and knowing implies that IK becomes defined not only in terms of specific forms of knowledge *content* which, as Khupe (2014, 18) notes, is "local and specific to place", but includes "*ways of knowing*" especially in cultural traditions where "verbs are more central than nouns" (Khupe 2014, 18, our italics). IK styles of knowing are often regarded as holistically oriented in the sense that "the world is not viewed as isolated parts" (Khupe 2014, 162) and, as indicated above, the knowing is recognised to be rooted in collectively generated constructions.

Clearly, a broad range of scholars and supporters of IK (e.g. Adyanga (2012), Battiste and Henderson (2000); Dei (2008); Gumbo and Williams (2014); Iseke-Barnes (2005); Kincheloe and Steinberg (2008); Romm (2010, 2015a, 2017); Wane, Manyimo, and Ritskes (2011); and Knudson (2015)) have defended the fact that different cultural heritages and social groupings of people in society can harbour unique ways of knowing. With the above in mind, this article extends the current debates about IK by examining voices from the field in relation to ways of understanding IK within the school context.

We chose as our domain of inquiry what is called *beginning knowledge* in the primary school context (as per the South African curriculum) as this knowledge is open and introductory and can in principle already teach learners how they might "hang" science onto household and community practices with which they are familiar. Such knowledge at primary school level could, if matched to IK world views, provide a basis for fostering at an early age IK understandings of sustainable development as linked

1 Indigenous people can be defined as people who have a "historical continuity with pre-colonial societies that developed on their territory" (Gumbo 2012, 437).

to ways of caring for the environment—thus supporting the curriculum content on "beginning knowledge" in relation to the environment (which includes, for example, caring for the land and conserving water).

SITUATING IK WITHIN A THEORETICAL FRAMEWORK

As a theoretical framework, the valuing of IK affirms that Indigenous people must honour their elders' and/or ancestors' teachings and processes of knowing while interfacing and/or creating connections with non-Indigenous people and their constructions (Adyanga 2014a, 2014b; Cajete 1994; Chilisa 2012; Dei, Hall, and Rosenberg 2000; Restoule et al. 2014; Wane, Adyanga, and Ilmi 2014). The theory champions the opening of space in which IK and dominant knowledges can enter into dialogue in formal education. The theory also conjectures the nurturing of local knowledges for home-grown solutions to local challenges and problems (Yankah 2004).

Accordingly, the use of this theory acknowledges the heterogeneity and non-hierarchisation of knowledge as articulated by Battiste and Henderson (2000) and posits the possibility of a viable integration of IK in formal education processes. In the context of South Africa, Gumbo points out that "the curriculum policy seems to be accommodative of IKS" (2012, 445). However, ways of organising IK integration seems for the most part to be left to teachers' discretion (see also Khupe 2014, 19).[2] In the light thereof, the research reported on in this article explored issues surrounding the implementation of IKS.

RESEARCH APPROACH

The study used a qualitative research approach—as explored by, for example, Denzin and Lincoln (1994), Lincoln and Guba (2013), and Merriam (2002)—in which participants were invited to reflect in an interview format upon routine and problematic moments and meanings in their lives. We organised the interviews with the help of a research assistant (RA) who, being the head of a language department at one of the schools in the community, was fully conversant with the local language siSwati and also with English. The aim of involving an RA who was fluent in siSwati was to ensure that the interview conversations could be primarily in the local language, which is not the native language of the principal investigators, namely, Adyanga and Romm.

The study was conducted under the auspices of the Gratitude in Education (GiE) project—a Unisa-funded community engagement project that is based in a secondary school in the study community and is aimed at offering support for Mathematics and

2 Khupe indicates that three major curriculum revisions have been made since 1994, with the latest revision being the Curriculum and Assessment Policy Statements (CAPS), introduced in 2011. He notes that "in all three post-apartheid curriculum documents, Indigenous Knowledge Systems (IKS) were included in the underpinning principles" (2014, 10).

Science teaching. The team leader of the GiE project introduced Adyanga to the principal of the school where the GiE project is based, as well as to a few respected members of the community. To build a relationship with the community, Adyanga interacted with the teachers at the GiE secondary school, voluntarily taught Life Orientation to Grade 11 students and invigilated examinations during the research period. This was a way of giving back to the community for sharing their knowledge, which is in line with the principle of reciprocity advanced by Indigenous research methodology (cf. Bubar and Martinez 2017; Chilisa 2012; González y González and Lincoln 2006; Kovach 2009). The primary schools where Adyanga, together with the RA, later conducted interviews with teachers are feeder schools for this secondary school. It is also worth noting that the reason why the Unisa staff involved in the GiE project focused this project in this area, is that it is a very remote area that borders South Africa, Mozambique and Swaziland and is more or less devoid of support. The idea was for Unisa to offer some support to teachers and in this process to also involve district officers in the community.

RECRUITMENT OF PARTICIPANTS

A total of 30 participants (15 primary school teachers and 15 elders from the community) were recruited and interviewed. All the teachers (eight males and seven females) who participated in the study identified themselves as South African by birth or citizenship and spoke the native tongue siSwati in addition to English. The RA recruited the participants from five primary schools. Another set of participants consisted of 15 elders (nine males and six females from the community) who identified themselves as South African-Mozambican, South African-Swazi and South African-Mozambican-Swazi. In this context it meant that they had close relatives in the countries mentioned.

RECRUITMENT OF TEACHERS

While the RA chose the five primary schools on the basis of convenience due to their proximity to his base (Dörnyei 2007; Onwuegbuzie and Leech 2007), he did not believe that they were very different in characteristics from other schools in the area. A homogenous sampling method was then used to purposively select the teachers based on the criterion of their teaching Science in the schools. The RA phoned the teachers individually and briefed them about the study before inviting them to participate. Those who accepted had the information and consent forms delivered to them. They signed and returned the forms to the RA who fixed dates for the interviews.

RECRUITMENT OF ELDERS

It happened that the RA knew all the elders in the relevant community. He had been born in that same community and attended his primary (elementary) and secondary

education there. Using purposive sampling, the RA identified and contacted elders for the study who were highly respected and had high social status in the community (which meant that they could be regarded as key informants). The criteria for their selection and participation included their being available at the time of the study and being easily accessible and willing to participate; hence elements of "convenience" were included. Using this method, seven elders, among who were traditional healers, senior royal palace officials and clan heads, were first recruited. Having gained a deeper understanding of the study focus, these seven elders referred the RA to other potential elders in their community, leading to the recruitment of eight more elders by means of snowball/referral sampling. This process is in keeping with the indication of Onwuegbuzie and Leech that "snowball sampling involves asking participants who have already been selected for the study to recruit other participants" (2007, 112–113). It also aligns with Kovach's (2009) notion of an "Indigenous relational sampling" method. The elders agreed to be part of the research because they knew the RA as someone with a good reputation in the community. In this regard Kovach states that "because of the relational factor in sampling, it is not simply a matter of the researcher choosing the participants. This process is more reciprocal" (2009, 126).

Use of the interview method

The interaction during the interviews with the teachers was structured largely around an interview guide, with some room for probing and also for clarifying questions. The first question in the interview guide was phrased as "What is Indigenous science knowledge?" Other questions that followed from the first one were:

- To what extent do you use this (Indigenous knowledge) in your teaching?
- How do you believe it can be integrated in teaching science in school?
- Do you feel that the current curriculum encourages you to integrate IK in science teaching?
- What status and relevance does IK have in formal education?
- What roles do you think elders in the community can play in the teaching of IKS?

In the interviews with elders, the interactions were more akin to conversations than to formal interviews and they followed a semi-structured (veering towards an unstructured) format. As noted by authors such as Josselson (2013), Kvale (2007), Romm (2001, 2015b) and St Pierre (2017), in relationally oriented interview situations participants are regarded as having their own agency, thus are not simply answering the questions posed by the interviewer. This orientation in the interviews enabled the participants to reflect on issues beyond the boundary of predetermined questions, hence making the engagement conversational. This method proved to be significant in generating new questions that were beyond the breadth of the original enquiries and solicited responses

and encouraging participants to raise issues they were concerned about and to suggest solutions.

FINDINGS AND DISCUSSION

Approach to data analysis

Data were analysed using the constant comparison method (Charmaz 2006, 2009; Onwuegbuzie and Leech 2007). After the RA had forwarded to us the transcribed and decoded data (translated from siSwati into English), we examined the transcriptions and started to assign codes. To do this, we uploaded the transcribed data into Atlas ti (a computer-assisted qualitative data analysis software program). Because the data had been collected in two phases (first the teachers and then the elders), the decoded data were uploaded to Atlas ti in that order. We first uploaded the teachers' verbatim voices and then identified, copied and saved the codes in a Microsoft Word file. We then followed the same process with the elders' verbatim voices. Afterward, we categorised the codes into what we called assenting and dissenting voices; that is, we categorised the convergent perspectives (those that converged around the idea of wishing to integrate Indigenous science in formal education) as "assenting voices", and the divergent views as "dissenting voices". On the basis of this categorisation, some predominant themes that emerged with high intensity from the two sets of data (teachers and elders) included, among others, the unclear status of IK in formal education and elders' significance in the debates about IK. We then worked back and forth between the assenting and dissenting voices while relating these to the literature, theory and our own interpretations as presented below. As MacLure (2017, 52) reminds us, there is always room for multiple interpretations and ways of making sense of the data as a whole. Our own sense-making admittedly involves a "creative assemblage" in the way in which we have put together the various views as expressed by the participants. Although the teachers were the first to be interviewed, we start off this section by discussing the elders' voices because all of the study participants put forward that the elders' views were important in understanding IK.

Elders' voices

Much as the focus of the study was on African Indigenous science, participants' responses reflected IK broadly, which included sex education, dance, spirituality, environmental protection, medicinal practices, and animal and crop husbandry. This demonstrates the interdependence of ways of knowing in IK. For example, when asked about the definition of Indigenous science, a male elder espoused that:

> I don't understand what you mean by science and knowledge, but in response, I think we should be talking about what we do in the Mbuzini [name of the village] community and how that which we do earns us a living, as in how do we do it that makes us and our children survive on the land, trees, water, hills and the animals that God gave us. So, our ancestors lived on this land and we inherited it from them with the ways [knowledge] to make this land productive and regenerative for many generations ahead. The ways to make this land regenerative is what I will talk about here as knowledge. This knowledge is rooted in our culture and spiritual domain and it is our way of life. It defines who we are as a people.

From the above, the argument that IK proclaims the spiritual and cultural foundations as the pillar for the local community's survival was reiterated adeptly by this elder.

Also tying the spiritual to science, a female elder pointed to the sacredness of the King's forest situated in the middle of the village. She asserted:

> For us in this community, African scientific knowledge implies obeying the teachings of our elders so that we get rain for our crops and animals, so that we have medicines to treat different sicknesses and live in harmony with each other. Look at that forest [pointing to the thick vegetation in the middle of the village], it is the King's forest. Since I was born, nobody except the King enters that forest, which he enters occasionally and during certain ceremonies. We are taught not to enter or gather fire woods from the forest and that any violation would be catastrophic and fatal. The forest is important to us, we can't abuse it, and because of this, we have enough rain for our crops and animals, we cultivate our land and have plenty of food.

Our interpretation of this extract, synthesised with other participants' perspectives, is that Indigenous science is understood in terms of cultural norms, social values, public health, livelihood management and mental constructs that form, guide and regulate people's livelihoods and serve to make sense of their world. This, we suggest, can be capitalised upon in incorporating global sustainable development goals (UN 2015) already at primary school level, where IK is tied to the livelihoods of local peoples as a product of a sustained process of creative thought and action within communities when local people struggle to deal with a continuously evolving set of challenges in their societies (Yankah 2004).

Grounded in the perspective of the female respondent quoted above, we can further interpret the spiritual significance of the forest to the community. Critically gazing beyond the spiritual dimension of the forest, we can link the restrictions levied on the forest to environmental protection because the mountainous community is heavily deforested with trees sparsely spread across the hills and valleys. The forest, located at the centre of the village, has a measurement of approximately 400 square metres consisting of huge, tall and old indigenous tree species. They act as wind breaks from strong prevailing winds since the village is located on the western side of the mountain (windward side) and receives heavy downpours during rainy seasons. With the population increment leading to pressure on vegetation coverage for farming and settlement, preservation of the forest in the middle of the village is required for environmental protection, a knowledge that is commensurable with Western knowledge—a confirmation of knowledge blend

and interface. This affirms that Indigenous people can honour their elders'/ancestors' teachings while interfacing/creating connections with non-Indigenous people and ways of knowing (Adyanga 2014a; Cajete 1994; Restoule et al. 2014). Here we see the interdependence of the scientific field of study with spirituality as an interwoven community driving force, as also explored by Finch (1983) and Wane, Adyanga, and Ilmi (2014).

When asked to comment on the examples of African Indigenous scientific knowledge being practised in their society, most participants' responses blended spirituality into herbal medicinal, agricultural, environmental protection and biological practices. Participants identified the use of herbal medicine, which many argued in most cases were intuitively revealed to the herbalists by supernatural beings. A male elder postulated:

> I am a "tinyanga" [doctor or traditional healer]. In our community, there are other doctors like myself who practise different forms of medicines to treat [different] diseases. From my experience living in this community, I have treated and seen many patients get healed of different conditions. But one thing I know is that some of the doctors also have spiritual powers which reveal to them new medicine for treating new conditions.

In this community where traditional African religion and Christian religion are deeply ingrained, spirituality cannot be separated from the way people make sense of their natural world in the process of knowledge creation. It is the bedrock of their survival that guides intra- and inter-community relationship building. Typical of most elders' responses, spirituality could be sensed in their tones, which feeds into the blendedness/interlinkage of different disciplines, such as philosophy, science, geography, agriculture/forestry, religion and medicines, in the study of IK.

Teachers' assenting voices

In this section we report on the views of those teachers who expressed a desire to see Indigenous science in formal education. We refer to this group of teachers who espoused the value of the integration of IK into the curriculum as *assenting voices*. Out of the 15 teachers interviewed, 11 of them argued that IK should be introduced in the curriculum. Their viewpoint is in line with the South African Curriculum Assessment Policy Statement (CAPS), which in turn is aligned with the national Constitution, which includes the valuing of IK systems in education (Gumbo 2012; Khupe 2014; Taylor and Cameron 2016). In response to the question about the status and relevance of Indigenous science in formal education, most participants stated that although CAPS required teachers to integrate IK in their teaching, it was still not clear to them how to accomplish this. Nonetheless, these teachers argued that IK should indeed be integrated into existing subject areas such as life orientation, science, mathematics, arts, music, and/or introduced under cultural studies (where learners should be taught to respect cultural diversity as well as knowledge diversity, taking into account that both "culture"

and "knowledge" are evolving). In the words of a male teacher, this would enable learners to:

> celebrate and respect cultural diversity and knowledge diversity that different societies in Africa and outside Africa are richly blessed [with] by the creator, thereby helping in training responsible citizens. … I support it [learning across cultures] because … learners gain other knowledge that could be beneficial to all societies including our own. While at the college [teachers' training college], I learned the principle of knowledge transfer and application, which is what I am applying to Indigenous science.

Here, the participant articulates the pluralism and fluidity of IK, as IK is brought into relation with "other knowledge" (and vice versa) in the learning situation. In addition, a female teacher posited that situating Indigenous science in the primary education curriculum could help struggling learners understand concepts. She enunciated:

> I think it is a creative idea that Indigenous science be added into the curriculum and I am happy to be giving my opinion in support of it. I hear that it is one of the requirements by the Government that educators should teach IK in the classroom. But as of now, there are no clear pointers as to how we can teach IK. But I think if we can get guidance on how to teach it, many of our learners struggling to understand concepts, for example in Math and Science, will be greatly helped. Because they will see a similarity between the contents they get from school and the contents they get from home much as the teaching style may be different.

This teacher did not specify from where she thinks teachers might obtain "guidance" as to how IK could be integrated. However, by her suggesting that "they [the learners] will see a similarity between the contents they get from school and the contents they get from home", she paid homage to the community and schools as centres of knowledge production. This feeds into the African proverbial saying that "it takes a village to raise a child" because the participant gave credit to the fact that home-nurtured knowledge could interface with the knowledge offered at school to improve learners' achievement.

Teachers' dissenting voices

Four of the teachers expressed their dissent about the integration of IK into the curriculum. They rejected such an idea, arguing that although IK was beneficial to society, it was already imparted to learners at home before they came to school. They cautioned against the duplication of imparting knowledge at school that students had already received from their home environment. A female teacher expressed concern about IK integration into formal education as follows:

> Indigenous knowledge is so much concerned with culture [and] teaching good mores and values. I therefore pause and wonder how I can teach this to my class. Besides, I am yet to see any teachers' guides that guide teachers on how to teach IK. So, with this, I think that the knowledge is better left to learners to acquire it from their community.

Further, dissenters spoke of cross-cultural values that had penetrated the society to the point that people were confused as to what Indigenous science was and what non-Indigenous science was. In elaboration, a male dissenter stated that:

> Because of cross-cultural infusion due to migration, many African people have infused different scientific elements into their practice. For instance, in my community, we are taught from home of the importance of washing hands before and after eating and after using [the] latrine/toilet. I construe this as an Indigenous hygiene practice since my understanding is that the teachings existed pre-colonisation of Africa and it is scientific. However, when I look at my lesson plan during natural science lessons, washing hands for personal hygiene is one element which I often communicate to my Grade 5 learners.

One could argue on the basis of this quotation that this teacher has identified how oftentimes what is taught in the curriculum already encapsulates Indigenous knowledge. This is one of the decolonialist arguments which avers that IK is not given its rightful recognition in "formal" knowledge.

The dissenting voices thus reasoned that some Indigenous scientific practices were already contained in the curriculum contents in formal education. They proffered that with the scarcity of financial resources, the addition of more epistemological strands in the curriculum risked overwhelming the already underfunded education system. The argument of these "dissenters" was also that resources such as government-approved textbooks, the internet, television programmes aimed at general audiences or trips to local museums often did not reflect the lived experiences of Indigenous students and teachers. Hence Romm (2015a, 417) advises critical scholars/educators to treat carefully the values that are brought to bear on a situation in which different world views are engaged with.

Possible strategies for IK integration

Regarding the methods that can be used to integrate and teach IK in formal education, there was a show of solidarity by assenting and dissenting voices with the recommendation that elders should be at the forefront. The unanimous views reiterate the respect, honour and value that this community attaches to elders. Accordingly, one of the teachers posited that this was one way of acknowledging the elders for their contributions to the community. Specifically, he reasoned:

> Much as I don't agree with the suggestion of adding additional knowledge [IK] in the curriculum, I think the task of educating teachers who in turn would educate the learners should be given to elders when proponents [of knowledge integration] win. It is a way of saying thank you for keeping the knowledge alive through your experiences, spiritual practices and the use of siSwati [local language] which you proudly preserved and passed to us, the young generation.

As it happened, when asked during the interviews if they would be prepared to teach IK if they were requested to do so, all the elders agreed that they would be pleased to do

that. But one (female) elder specified that "it's better they [students] come to me where I will speak in siSwati". Her expression implies an engagement in the discourse of possibility (creating her own teaching/learning space) where the validation of subjugated knowledge can safely occur (see also Wane 2008).

CONCLUSION

In this article we suggested that the integration of IK in formal education should be conceived as an effort to embrace diversity in ways of learning. It is through scholars' and local peoples' organising/activism that we can strive to build a new world by disrupting/contesting the dominant centre of knowledge production as a starting point of restructuring a new, more equitable world. Our research was admittedly located in a geographically "marginal" rural area; hence we cannot justifiably suggest the extent to which our statements (grounded in the participants' views) might transfer to other areas. Further research is needed to include urban and metropolitan areas to assess how (and whether) teachers are interpreting the curriculum by linking their teaching to Indigenous knowledge and practices. However, clearly, given that IK is necessarily what Khupe (2014, 18) calls "specific to place", there is no one-size-fits-all approach to specifying ways of integrating IK-directed science teaching in the school curriculum. What we would advise is that there is a need for further research on the varied and complex ways in which teachers could become more sensitised to IKS so that teaching can be linked to "authentic problems and place-based issues" (Khupe 2014, 18), while also ensuring that the human rights enshrined in the Constitution are acknowledged and nurtured.

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