CHAPTER 25

Decolonizing Science Education in Africa: Curriculum and Pedagogy

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Introduction

Science curriculum and pedagogy in Africa are often overly exam-driven, teacher-centered with colonial as well as foreign-leaning characterizations. This apparent static nature of curriculum and pedagogy is due in part to emphasis on passing examinations and the perception that innovative pedagogies such as those attuning to contemporary issues such as understanding science through local African contexts is considered time wasting (Sifuna & Otiende, 2006). Moreover, initially those in Africa and in the diaspora who may be positioned to influence change are often trained abroad, or trained locally by foreign experts, thus lacking the skills needed to reform curriculum and pedagogy to reflect the local context (Sifuna & Otiende, 2006). In addition, they often tend to borrow from foreign instructional models not suited for the African learner. This has made students less inclined to contextualize what they learn and especially with regard to understanding the scientific phenomena embedded in their local contexts. As well, the students are less welcoming to decolonizing pedagogies that place context as central to meaningful and relevant learning of science. Instead, they focus more on how to pass their examinations. The need to understand science contextually, which is a central tenet in decolonizing science education, is regarded as superfluous to examination performance and, at best, perpetuates the traditional culture where science is

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understood as an encapsulated system that has no relevance in terms of their local contexts and everyday lives (Tsuma, 1998). This chapter will highlight ongoing research by the author where specific local contexts in an African setting have been successfully used to develop curricular units that engage students in unpacking and understanding scientific phenomena embedded in their local context as a way of decolonizing science curriculum and pedagogy. Using examples of contextualized curricula in investigating student science learning and its effect on teachers' teaching, the author will draw upon the research studies he has been doing in Kenya for the last 15 years where national curriculum is interpreted and implemented through a series of contextualized lessons with student learning and teachers' teaching analyzed. But first, it is important to provide the historical foundations on which Kenyan curriculum has evolved.

Background

Kenya, like many developing countries, faces many significant environmental challenges, particularly around local manufacturing and degradation of the natural environment (Ce'car et al., 2014), which are given little prominence or attention in the school science curriculum. Although there have been attempts through numerous educational reforms to make school science relevant in post-independence Kenya (Gachathi, 1976; Kamunge, 1988; Koech, 2000; Mackay, 1981; Ominde, 1964a, 1964b), the question of relevance and impact has continued to persist. These attempts to reform education have included linking science learning to production activities and products in Kenya's ubiquitous *Jua Kali sector* (Nyerere, 2009; Swift, 1987; Waddington, 1987). "*Jua Kali*" is a small-scale manufacturing and technology-based service sector (UNESCO/UNEVOC, 1998). The name is derived from the conditions (scorching sun) under which the artisans who manufacture equipment and provide related services to other small-scale producers operate.

This question of relevance is still a key part of the ongoing discussion about the reform agenda including two previous major Social Science and Humanities Research Council (SSHRC) of Canada funded studies (2006 & 2010) from which important insights into the ways science is taught and understood contextually were generated. It was the view of the investigators of which I was a principal investigator that making science relevant through local contexts is a key decolonizing strategy for science education. When students are judged to understand science through the lens of their local environment and explain events in real life in terms of the science they learn, then we can reasonably claim a degree of meaningful learning from relevant contexts and hence a decolonized curriculum and instruction. Here, students tend to own the learning process and indeed take responsibility for their own learning.

Further analysis of the current discourse among stakeholders (e.g., the *National Council for Science and Technology* [NCTS], the *Kenya Ministry of Education*, and the *Kenya Science Teachers Association* [KSTA] and the *UN*

Environmental Program [UNEP]) about how to make science relevant still indicates a collective desire to understand science contextually. And, in particular, there is ongoing desire to develop and implement curriculum that enables students to investigate and understand the science embedded in effects of manufacturing activities and products on local environmental sustainability. This is especially important to Kenya given its vision of attaining industrialized nation status by 2030 (Government of Kenya, 2007). Furthermore, there is strong evidence that there is value in understanding the science embedded in local environmental issues (Hodson, 1994; Nashon, 2013).

The team that I led in implementing the studies has extensive understanding about the Kenyan learner in particular, including (a) how students struggle to learn in Western-modeled classrooms (Nashon & Anderson, 2008a); (b) the need for meaningful assistance to change from cultural worldviews to canonical science (border crossing) (Aikenhead, 1996); (c) the desire for a moral obligation to assist others—collaborative classroom culture. In other words, there was a desire among the students and teachers who participated in the studies to not leave their peers behind, and hence, the "walking together," a practice that is resonant with local socio-cultural practices (Gitari, 2006); (d) a respect for cultural knowledge as well as canonical science, and the ability to hold both worldviews and use them relevantly (collateral learning) (Jegede, 1995); and (e) the importance of relevance in science learning (Knamiller, 1984). These understandings are vitally important for teachers to embed in their pedagogies the learners' local settings with a view to making science learning relevant to Kenyan students. Moreover, these insights are key to designing effective, learning experiences for contemporary classrooms in Kenya and in other developing countries. However, in today's Kenya, like in many other African countries, these insights are still not fully harnessed by the education system (Anderson et al., 2015; Nashon, 2013; Tsuma, 1998). But clearly, all these learner attributes can be effectively mediated through contextualizing science learning. For example, this can in part involve students in understanding the science embedded in the effects of the ubiquitous local Kenyan *Jua Kali* activities on their local environmental sustainability.

Curriculum and Pedagogy in Kenyan Classrooms

In Kenya today, as already highlighted above, science curriculum and pedagogy are often overly exam-driven and teacher-centered with colonial, as well as foreign-leaning characterizations (Ooko et al., 2017; Sifuna & Otiende, 2006). This apparent static nature of curriculum and pedagogy is due in part to a pedantic emphasis on passing examinations and the perception that innovative pedagogies such as those attuning to contemporary issues, such as environmental sustainability and learning in the local contexts, is a waste of time (Nashon, 2013; Sifuna & Otiende, 2006). The pressure of passing exams often has many Kenyan students less sensitive to environmental discourses, but rather they focus more on how to pass exams. The need to understand science contextually, is regarded by both teachers and students as being superfluous to examination performance, and at best, perpetuates the traditional teaching culture where science is understood as an encapsulated system that has no relevance in terms of local environmental sustainability or the local context (Julius & Wachanga, 2013; Tsuma, 1998; Wachanga & Mwangi, 2004). Any attempts to integrate into curriculum visits to authentic science learning environments, such as *Jua Kali* or local forests where they can engage with the science embedded in the effects of *Jua Kali* production activities on the local environmental sustainability are seen as a "waste of time." But for most Kenyans, the question of relevance is very important as eloquently expressed by Tsuma (1998): "no Nation can develop in any sense of the term, with a population which has not received a thorough and relevant education" (p. i). And, although there have been attempts to demonstrate the richness of *Jua Kali* in scientific phenomena (Anderson et al., 2015; Nashon, 2013; Nashon & Anderson, 2008a, 2008b, 2010, 2013a, 2013b; Nashon & Madera, 2013; Nashon et al., 2015; Ooko et al., 2017), there has not been extension of these reforms in school curriculum to investigate how students understand the science embedded in the effects of *Jua Kali* production activities and products on local Kenyan environmental sustainability. Hence, there is a need to have students in Kenya engage in the more contemporary global question of environmental sustainability. Importantly, there is the need to have students unpack the science embedded in the effects of *Jua Kali* production activities and products on their local environmental sustainability as a more relevant and meaningful science learning strategy. This is what I consider an important motive toward decolonizing science education in Kenya and for that matter in Africa This approach holds the potential to lead to a more scientifically and environmental sustainability oriented and prosperous society. Moreover, it will lead to the betterment of the natural physical environment of the nation through environmental stewardship of informed citizens.

Learning from Ongoing Research

Insights from previous SSHRC-funded studies (2006 & 2010) that I facilitated caused my team to raise questions about students' understanding of the science embedded in the effects of *Jua Kali* production activities and products on their local environmental sustainability. Noteworthy, among the many *Jua Kali* production activities and products from which scientific phenomena and local environmental sustainability can be investigated, the *charcoal stove* stands out to be of significant importance because: (a) it is ubiquitous and used daily by students in most households across Kenya; (b) it uses natural resources including charcoal, although varieties are being produced that use sawdust, kindlers, or agricultural residues—all of which are in limited sustainable supply; (c) there are vigorous innovations in the *Jua Kali* regarding production of the most efficient charcoal or agricultural residue stoves—so as to improve efficiency and cook most food using minimum fuel resources;

and (d) its use has very significant implications on degradation of forests and other rare plant and tree species sustainability. According to Beru et al. (2014), the connection between sustainability and the production of such stoves has profound implications on Kenya's wood fuel sources—the forests. Despite such obvious connections between real world issues, school science discourses do not include understandings of science embedded in the effects of *Jua Kali* production activities and products on local environmental sustainability. These issues have been evoked by insights from the 2006 SSHRC funded study and engagement with students in Kenya where: (1) students understood science better in a canonical sense when instruction used local contexts to mediate curriculum; (2) students were provoked and inspired to make critical assessment of their prior learning strategies and habits by fascinating and contextualized experiences; and (3) students became acutely aware that the learning strategies they used were a consequence of the nature of the prevailing curriculum and lack of pedagogical models that make science relevant (Nashon, 2013; Nashon & Anderson, 2008a, 2008b, 2013a, 2013b; Nashon & Madera, 2013; Nashon et al., 2015). Also, the latter 2010 study revealed how the Kenyan teachers' teaching was impacted by this way of student learning including: (1) the teachers' literal and rigid interpretations and strict adherence to the official curriculum conflicted with the students' desires to understand scientific phenomena embedded within their local environment; (2) the science teachers' inability or ability to sustain students' motivation to understand science through local contexts in part depended on their initial teacher training; and (3) implementation of the contextualized science reduced the gulf that often hindered free student–teacher dialogue due to the teachers' endeavors to maintain science and teacher statuses (Anderson et al., 2015; Nashon, 2013; Nashon & Anderson, 2013b). With this knowledge platform, the investigation has been extended to include high school students' learning and understanding of the science embedded in the effects of *Jua Kali* production activities and products (local manufacturing) on their local environmental sustainability in Kenya.

Significantly, the outcomes of the 2006 study led to a deeper appreciation for the notion that natural *modes* of learning are uniquely culturally mediated and harnessing this understanding can profoundly transform science curriculum and pedagogy in Kenya, Africa and elsewhere. Although the study, which focused on Kenya, has given us deeper understandings about Kenyan learners' modes of learning and the kinds of experiences that evoke as well as provoke these natural modes of learning, and which transformed the students' perceptions of the nature of science and science learning, very little was understood about the collateral impact the transformations had on the science teachers' pedagogy and school culture. And, given the demonstrated effectiveness of the study's innovative contextualized curricular and pedagogical experiences on student science learning, it became imperative to frame a study that documented, interpreted, and understood transformations in (1) science teachers' professional and social cultural values surrounding educational practices, and (2) school culture.

The 2006 SSHRC funded *Canadian-East African Collaborative for the Study of Ways of Knowing* (CEACSWOK), which investigated and elucidated East African (EA) students' ways of knowing (WOK) that were invoked and engaged as the students experienced integrated classroom-*Jua Kali* science curriculum activities, now became the *Canadian-East African Collaborative for the Study of Student Learning and Pedagogy* (CEACSSLAP) as a way of extending the investigation into the collateral impact of successful transformations in student learning had on their science teachers' teaching practices and socio-cultural values and school culture in the reformed science curriculum and pedagogy. As a team, we investigated transformations in East African science teachers' socio-cultural values surrounding their professional practices as well as collective changes in school-culture as they journeyed through changes in both curricular and pedagogical reforms. The outcomes of the study had implications on our current understandings of culturally based pedagogies and their application to curriculum and instruction beyond the traditional Western models. Moreover, these extended understandings about the African and for that matter indigenous learner as demonstrated in Jegede's (1995) notion of collateral learning; Aikenhead's (1996) notion of border crossing; Gitari's (2006) notions of moral obligation and knowledge guarding; and Anderson and Nashon's (2009) notion of natural *harmonics* of the African learner. These understandings are key to designing effective, inclusive learning experiences for our contemporary multicultural primary, secondary and post secondary classrooms. As already highlighted above the 2010 study about the effect of student learning on the teachers' teaching practices and school culture was inspired by the outcomes of the 2006 SSHRC funded research study that generated important insights about curricular and instructional experiences that are in harmony with the students' natural (cultural) modes of learning (Anderson & Nashon, 2007; Nashon & Anderson, 2008a, 2008b; Nashon & Madera, 2013). The outcomes led to a deeper appreciation for the notion that natural *modes* of learning are uniquely culturally mediated and harnessing this understanding could profoundly transform science curriculum and pedagogy in EA and elsewhere.

Although the study focused on Kenya, it offered deeper understandings about the Kenyan learners' modes of learning and the kinds of experiences that evoke as well as provoke these natural modes of learning, and which transformed the students' perceptions of the nature of science and science learning. Hence the questions: What transformations are notable in science teachers' socio-cultural values and collective school-culture surrounding professional practices as they journey through both curricular and pedagogical reforms? What theoretical and practical insights can be gained from the teachers' and schools' professional transformations as they navigate through curricular and pedagogical reforms? These kinds of questions were considered suitable for investigation using a socio-cultural framework (Kozulin, 2003; Rogoff, 1990) due to its emphasis on the importance of human interactivity within social settings, and an interpretive methodology (Schwandt, 2003) that employed case studies (Stake, 1995) to generate rich descriptions of transformations in the teachers' pedagogical knowledge (Shulman, 1986) and school culture (Goodlad, 1984).

The outcomes of the study included development of new theoretical understandings about collateral impact of students' successful learning on teachers' teaching practices and socio-cultural values as they journeyed through and experienced their students' success in reformed science curriculum and pedagogy.

As already argued, there still continues to be no strong curriculum link between activities in the *Jua Kali* that have come to characterize the common socio-cultural environment of many young Kenyans and for that matter many East Africans, their school science (classroom knowledge) and the ways in which they learn, which are culturally shaped (Cobern & Aikenhead, 1998). *Jua Kali* (a Kiswahili word derived from conditions under which artisans operate—*scotching sun*) has products such as charcoal stoves, kerosene lamps, and chicken brooders, all of which are prevalent household items ubiquitous in everyday Kenyan culture and rich in scientific phenomena. But, any attempt to link classroom science to the real world of *Jua Kali* activities cannot be effective if there is no understanding of students' natural ways of learning embedded in their worldviews of science learning, which are shaped by their socio-cultural environment. Moreover, even with such an understanding, the link may not be effective without also understanding how teachers' teaching practices and socio-cultural values, and collective school culture are impacted as they journey through and experience their students' successful learning resulting from their engagement of their natural modes of learning evoked by the context in which the teaching and learning take place. All of this is situated against the contextual backdrop of school curriculum and pedagogy that are based on traditional western models, exam-driven, and highly teacher-centered.

Moreover, this being situated in the larger body of literature on indigenous peoples' ways of learning attempted to fill the void that existed in this body of literature about the EA learner, under the inescapable influence of the socio-cultural environment in which the learner resides. Studies in the 1970s and 80s documented different WOK and how what students bring to science classrooms, a product of their WOK, impacted classroom learning and teaching. These ideas were referred to variously as children's science or alternative frameworks (Driver et al., 1997), lay science (Furnham, 1992), plain common sense (Hills, 1989), naïve science (Nickerson, 1986). According to Hodson (1998), these ideas are formed in many ways including talking with others, interaction with media, visits to other settings such as zoos, museums, amusement parks, etc. Moreover, Hodson adds, everyday language use influences their understanding of phenomena experienced in life. There have been attempts to explain how these ideas are constructed. For instance, Cajete (1999) reveals how Native science as a way of life is derived from lived experiences and practice within Native communities. He adds: "Native life in community is a primal pathway to knowledge of relationship with the natural world" (p. 99) (see also Beck & Walters, 1980). Other studies have been conducted among the Chinese, African American, etc., and most point to the fact that there is WOK that goes beyond the traditional Western thought. Thus, the argument in this chapter is that tapping into these ways of knowing through local contexts is a great way to decolonizing science education and pedagogy and enhancing canonical science to be relevant and meaningful to this learner.

A study by Guerts (2002) revealed pointers to the uniqueness of some of the ways Africans construct knowledge. She has challenged the commonly held assumption in the Western thought that "all humans possess identical sensory capabilities and that any cultural differences we might find would be inconsequential" (p. 3). For example, one outcome of her ethnographic study of a community in Ghana, West Africa identifies bodily ways of gathering information as profoundly involved in society's epistemology and the development of cultural identity. What this demonstrates is how framing science within local cultural contexts is critical to moving toward decolonizing our curriculum and instruction. Similarly the work of Jegede (1995), Aikenhead (1996), and Aikenhead and Jegede (1999) in Canada and Africa shows how cultural practices profoundly influence the way students *collaterally make sense* (hold multiple worldviews) of the world (see also Baker et al., 1996; Cobern & Aikenhead, 1998). The equivalent in Western cultures is what some scholars call cognitive apartheid (Cobern, 1996; Cobern & Aikenhead, 1998; Young, 1992). According to Cobern (1996), the students simply wall off the concepts that do not fit their natural worldviews and instead create a compartment for scientific knowledge from which it can be retrieved on special occasions, such as school exams. Moreover, as Young (1992) notes: "…this is likely to be more common if the new challenges the old. Under such circumstances, it is difficult for the new knowledge to be really made the pupil's own, a part of reality. It gets learned in a shallow way and … easily forgotten after the last examination, if it was ever really understood in the first place…" (p. 23). In other words, colonization is the fodder for shallow understanding of the world around the African learner as Western thought presents science as if it is delinked from the learner. But contextualizing the learning process is the methodology for decolonizing science education.

For East Africans (EAs), *Jua Kali* forms an important part of their construct of cultural identity, and, hence, is a key locus to understanding their way of learning science. But what the 2006 SSHRC funded study on students' ways of knowing in science discourses revealed is that if instruction is organized in ways that are in accord with the students' natural modes of learning, the learning process changes dramatically as the students start to see and appreciate the relevance of the science concepts to their local cultural contexts generating in them a motivation to understand the science embedded in their local environment or understand science in terms of their local environment (Nashon & Anderson, 2008a).

Whereas this study was largely situated in constructivist literature that focuses on students' preconceptions, the emergent analyses have moved it more into the literature on socio-cultural frameworks, with the realization that the students have natural (cultural) modes of learning that are culturally shaped and that harnessing these modes of learning to organize science instruction might be more fruitful in terms of learning canonical science in a more relevant and meaningful manner. This is what I consider to be a key step in decolonizing science learning. Studies such as these are better framed when they take into account emergent literature on pedagogical content knowledge (Shulman, 1986). Moreover, an assumption that is commonly made, indeed a fundamental premise of teacher ethnography, is that teachers' life experiences influence the kind of teachers they become, our views on teaching, and ultimately the way they teach. It is this understanding that motivates an investigation into how teachers are impacted by their students' learning experiences, hence making the project more holistic by studying student learning and pedagogy as an intertwined enterprise. What such an investigation aimed to demonstrate was how decolonized or contextualized science learning can impact the teachers' subsequent teaching. It is the influence of children's success that is most important, as it is central to curriculum decolonization.

Shulman (1986) introduced the term pedagogical content knowledge (PCK) as "the ways of representing and formulating the subject that make it comprehensible to others" (p. 9). Schulman's version of PCK refers to teachers' interpretations and transformations of subject matter knowledge in the context of facilitating student learning. Following Shulman's work, numerous studies have been conducted on teachers using a variety of interpretations of PCK. According to Abd-El-Khalick (2000), the construct has been studied among teachers including science teachers. Emerging from these studies is the assumption that the view that PCK is a separate domain of knowledge and that teachers' knowledge of subject matter directly translates into their teaching practices. But as Abd-El-Khalik (2000) notes the assumption has come under challenge by empirical research (e.g., Gess-Newsome, 1999) and that there is no emerging literature base that illuminates the re-conceptualization of the originally vague construct of PCK (e.g., Gess-Newsome, 1999).

However, there seem to have emerged a consensus on the nature of PCK as the experiential knowledge and skills acquired through classroom experience (Gess-Newsome, 1999), and as the integrated set of knowledge, concepts, beliefs, and values which teachers develop in the context of the teaching situation (Gess-Newsome, 1999). Thus, experienced teachers possess an integrated and developed understanding of teaching.

This perspective is consistent with Gess-Newsome's (1999) integrative and transformative models of PCK. The integrative model which comprises knowledge domains of content (subject matter), pedagogy, and context is considered to exist as separate entities, similar to a mixture of rice, sorghum, and wheat grains. Adherents (Fernández-Balboa & Stiehl, 1995) of this type of PCK argue that proficiency at any of the components of the mixture would enhance the whole PCK. Moreover, they argue, having knowledge about the components of PCK independently determines a teacher's ability to integrate these components. On the other hand, adherents (Marks, 1990) of the transformative model consider PCK as a synthesized knowledge, where content and pedagogy are integrated and transformed into classroom practice. And that it is impossible to distinguish PCK from either subject matter knowledge or general pedagogical knowledge. Yet many studies have continued to show that a majority of beginning teachers tend to rely more heavily on one domain of knowledge rather than drawing simultaneously from all domains, as is the case with an expert teacher (Ball & Bass, 2000; Davis, 2003; Grossman, 1990), which indeed was noted in the CEACSWOK study. Therefore, the integrative model may likely portray the PCK of beginning teachers, while the transformative model is more suitable to represent the PCK of experienced teachers. But it is not just as simple as that—to lay this only on beginning teachers. To the contrary, the blame for the case of East Africa, and Kenya for that matter can be attributed to an overly exam and teacher-centered curriculum where "objective" content is assessed. Otherwise pedagogic content knowledge may depend on complex interactions between discipline knowledge, pedagogic knowledge, and the teacher's experiences in teaching that knowledge. In one of my numerous studies with teachers, the study about the status of Physics 12 in BC, the physics teacher, and teaching styles were prominently mentioned as impacting students' decisions about Physics 12 (Nashon, 2003; Nashon & Nielsen, 2007). In the same vein literature indicates that quite often science teachers conform to instructional models they were exposed to as high school students (Blanton, 2003).

Thus in an attempt to contextualize science learning and teaching, which basically was about decolonizing pedagogy, the team I worked with on the Kenyan study, co-developed and implemented the reformed science curriculum units with the science teachers. In this way my co-principal investigator, David Anderson and I hoped for a high possibility that the teachers' pedagogy got impacted, especially given the successful learning experienced by their students. The knowledge and practice of a teacher to provide the most useful teaching situation is to make a topic comprehensible to learners (Shulman, 1986). Although there are several models, Gess-Newsome's (1999) integrated and transformative model complemented by the socio-cultural theory is very important in interpreting this kind of teaching and learning. Although Gess-Newsome (1999) uses the venn diagram to illustrate integrative view of PCK, when distinct parts of a mixture are visible and can be picked out easily, one can also see in the same diagram a transformative view, where the analogy of white light (Green + Red + Blue) is applied to signify transformative PCK—parts not easily seen or white light seen as a whole but components not visible (Fig. 25.1).

The study with Kenyan science teachers adopted the two models for the purpose of understanding the East African teachers' PCK in terms of overall transformation and the integrative model to understand where deficits or credits might exist in their PCK, and in particular to locate which aspects of PCK were impacted. Whereas, the two models as conveyed in literature seem to show one as better than the other, the Kenyan research team applied both complementarily in terms of understanding teachers' professional practices. These models are best complemented by the socio-cultural theory because

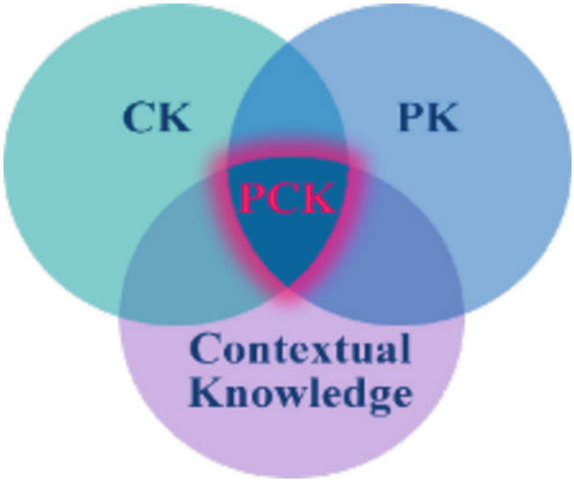

Fig. 25.1 Integrated and Transformative Model, Gess-Newsome, 1999

I consider teaching to be a social as well as a cultural act, enacted in a cultural environment.

According to Lantolf (2006), sociocultural theory considers human psychological development as being mediated by physical and symbolic tools, and that these evolve over time as cultural representations including language (Wertsch, 1998; Vygotsky, 1986). It further premises that practical and intellectual activities do not occur in isolation. Thus, there exists a strong and essential relationship between learning processes and their cultural, historical, and institutional settings (Wertsch, 1998). Wertsch further adds that learning cannot be separated from the influence of an individual's social and cultural worlds. In a similar vein teaching cannot be separated from the influence of the social and cultural worlds where it is enacted.

Inspiration

The interest in WOK stems, in part, from another study (Nashon & Anderson, 2004) that investigated students' metacognition across learning contexts, which revealed interesting insights into the role students' socio-cultural background plays in how they make sense of classroom and out-of-school experiences in Canada and Japan. For example, the study revealed cultural differences in the way Japanese students verify their views with references to peer groups in specific ways the Canadian students do not (Hisasaka et al., 2005). Moreover, Nashon's (2003) work on the nature of analogies that Kenyan teachers and students use in the teaching and learning of physics concepts revealed that the analogies were largely anthropomorphic and environmental—that is, culturally constructed (Nashon, 2003, 2004). A similar study, conducted in Nigeria, West Africa by Lagoke et al. (1997), revealed how biology instruction, which employed the use of environmental and anthropomorphic analogies, led to a reduction in the gender gulf in performance. In addition, Nashon's study in Uganda, which examined students' conceptions of HIV/AIDS, showed that most students understood HIV/AIDS in anthropomorphic and environmental terms (Mutonyi et al., 2010). This reiterates the argument that contextualizing science curriculum and instruction is a critical aspect of decolonizing science pedagogy in Kenya and for Africa and elsewhere.

Conclusion and Ontological Position

In advocating for the decolonization of curriculum and pedagogy in Kenya and Africa for that matter, I espouse and am guided by ontological and epistemological commitments that consider learning to be occurring holistically and not in isolated contexts as well as a dynamic process developed through experiences that are interpreted in the light of the learners' prior knowledge, attitudes, and personal background. Furthermore, I consider the socio-cultural identity of the individuals and the group to which they belong as determining the cultural tools (Ways of Knowing) that they use to make sense of the world. Also, I believe that, students' Ways of Knowing (WOK) rarely develop instantaneously, but rather, through catalytic events that connect classroom science to the real world and these have the potential to gradually affect WOK over a period of time. I also believe that although there are diverse WOK, some of the WOK can propagate misconceptions. I acknowledge the unique ways in which science differs from other ways of understanding and interpreting nature. But if the learning discourse is framed in the learners' local environment with a focus on interpreting the embedded science, then I consider such learning to be relevant and meaningful. This in essence, forms the background on which I advocate for decolonizing pedagogy through contextualization as a way of making science relevant and meaningful to the African learner.

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