The Interface of Neoliberal Globalization, Science Education and Indigenous African Knowledges in Africa

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Abstract: *In a globalized neo-colonial world, an insidious and often debilitating crisis of knowledge construction and legitimation does not only continue to undermine the local and indigenous knowledge systems, but it also perpetuates a neo-colonial and oppressive socio-cultural science educational system that debilitates the social and cultural identity of the indigenous African student. As Schissel and Wotherspoon (2003: vii) argue, "Educational relations are critical elements of our humanity and sociability." This paper explores the homogenizing effects of globalization and the oppressive forces of neo-colonialism that continue to work together to privilege "western-based scientific knowledge" at the expense of indigenous knowledge systems. As a result, valuable indigenous African scientific knowledge is in danger of being lost to indigenous communities, and students are not learning bodies of knowledge representative of their community knowledge, resulting in a diminished identity formation. The paper argues and concludes that indigenous knowledges/sciences have a role to play in identity formations of indigenous African learners and the students need to become knowledgeable in both African indigenous knowledge and Western dominant scientific knowledge through critical pedagogies and pedagogy of place.*

1. Introduction

With the imposition of neoliberal globalization and Eurocentric science education in Southern Africa, how do African people develop their African humanity and sociability? If neoliberalism and globalization, as I argue in this paper, marginalize indigenous African knowledges/sciences, how can the African students and people, in general, reclaim indigenous sciences to act upon

their natural world? Indigenous knowledges are known for their resilience and ability to describe, explain, predict and negotiate nature. Can African indigenous science and ways of knowing survive the onslaught of neo-colonialism and globalization?

In this paper, I define African indigenous science as culturally-specific knowledge systems that relate to the knowledge of the original peoples of Africa, their oral culture and traditional ecological knowledge, as affected by their worldview; the knowledge that incorporates their social and natural wellbeing, their cosmos and their spiritual world. It includes plant biology, environmental education, and other education centred activities such as manufacturing, agriculture, food processing, civil engineering, animal husbandry, transportation, mining, and communication (Snively and Corsilglia, 2001). Indigenous science classifies objects, activities, and events in its given universe and interprets how the local world works through a particular cultural perspective to interpret and understand social and natural phenomena. Expressions of science thinking are abundant throughout indigenous agriculture, astronomy, navigation, mathematics, medical practices, engineering, military science, architecture, and ecology. In addition, processes of science that include rational observation of natural events, classification, and problem solving are woven into all aspects of indigenous cultures (Snively and Corsiglia, 2001). Students who are exposed to this knowledge are capable of making sense of their lives and develop a cultural identity that mirrors their social and cultural communities. African science education has been criticized for lacks of relevance to African cultures, being a collection of facts from 'western' science with little or no adaptation and less critical, and fact-transmission oriented pedagogy.

The purpose of this paper is to argue for that indigenous knowledges/sciences have a role to play in identity formations of indigenous African learners. The article also discusses the need for African students to become knowledgeable in both African indigenous knowledge and Western dominant scientific knowledge through critical pedagogies and pedagogy of place. A hybridization of sciences provides students with critical perspectives in developing scientific knowledge, skills and attitudes and this

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can happen, if the influence of social needs and situations on science education is emphasized. Science courses seem more relevant to those students with science career aspirations and not to the majority for whom secondary science is terminal.

2. Literature Review

Curriculum Policy and Science Education

The formal education that indigenous African students receive does not merely serve the purpose of transmitting formal lessons and bestowing credentials, but also develops social and cultural identities. But these identities built on cultural learning are under threat from neoliberal constructs of knowledge and science education. A perusal of some science curriculum innovations implemented by most African countries indicates a Western bias in the content and practice. The content and practice of science alienates African students. Science education and its effects on students' identity formations are determined by the science curriculum in place. Curriculum innovations have been a central focus of curriculum scholars and policy makers in Africa. In most cases, innovations carried out after independence did not focus on the cultural and the place of learners in science learning. This raised critical questions about whether innovations were introduced to please foreign donors or to bring about substantive changes in education. Expectations were that, after independence, African governments would decolonize their science curricular through integrating socio-cultural expressions and insights.

While curriculum changes were deemed necessary to refocus knowledge and pedagogy on African perspectives, research indicates that most curriculum changes were promoted by outsiders, mainly western countries and donors. Some changes that were introduced in Africa were a 'copy cat' of Western curriculum forms. In Francophone Africa, 'transnational' knowledge was borrowed from France sometimes with little or no involvement from local or regional players (Holsinger and Cowell, 2000). Local input in the form of indigenous knowledges or sciences was largely ignored. In

South Africa, an outcomes-based curriculum in science and other subjects, known as Curriculum 2005, was developed for the purpose of reclaiming knowledge and cognition among South African students. However, instead of it being a local initiative, its origins and evolution can be traced to competency based debates in Australia, New Zealand, Scotland, Canada and the United States of America (Cross, Mungadi and Rouhani, 2002). Hence, the curriculum has been criticized for creating a solution to skills and job concerns without addressing the cultural cognitions of students and indigenous peoples input to knowledge thus, imposing a Western perspective and cultural imperialism (Kallaway, Kruss, Donn and Fataar, 1997).

In Rwanda, changes in science curriculum were designed with the help of a curriculum design 'specialist' from Canada to harmonize the primary and secondary curriculum in all subjects. The final document neither included cultural knowledge, skills and attitudes nor reflected critical pedagogical practice (Jaya and Treagust, 2002). In Nigeria, although Odunbunmi (1986) does not explicitly report on the importation of science curriculum, the author notes that science curriculum is a laboratory based subject that focuses on designed experiments that lead to generalizations of findings. Ogunniyi (1986) also observes that the processes of science provide students with unique opportunities to study abstract concepts and generalisations. From this perspective, scientific knowledge is divorced from pedagogy of place, the socio-cultural contexts of learners, and the cultural material that students interact with in their daily lives in their communities.

Besides reproducing curricular from western countries, some African countries have had their policies influenced by international organizations such as the World Bank and United Nations Educational, Scientific and Cultural Organization (UNESCO). Hassan (1997) observes that in Egypt, patterns of science education and new programs and systems were introduced with outside assistance from international organizations (Hassan, 1997). In countries like Sierra Leon, the World Bank played a major role in curriculum diversification (practical and vocational oriented subjects) and science education reforms which did

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not take into consideration incorporating indigenous knowledges and sciences in their models.

Tanzania is one African country which is usually credited for having implemented a home grown curriculum through Mwalimu Julius Nyerere's philosophy of Education for Self Reliance which focused on changing the content and practice of knowledge for primary schools so that it reflected community life, while secondary school science remained symmetrical to western curricular. For example, O-saki (2007) reports that *Inquiry Science* curriculum, in Tanzania, was imported from the USA and Britain. Interestingly, the first curriculum materials for primary school science program (PSSC) came from the USA, while the Nuffield Science Project for secondary schools was from Britain. Curriculum importation was similar throughout East Africa then, namely, Kenya, Uganda and Tanzania (O-saki, 2007). Holsinger and Cowell (2000) report that after independence, many African countries adopted the UNESCO biology project, the African Education Programme, and the adaptations of the PSSC physics which were designed by the Education Development Centre of the USA, and the Nuffield Science Programme of Britain. Even when Tanzania localized its examination system, the content of science and mathematics continued to reflect western forms with very little or none of the indigenous sciences that should have been relevant to students' lives.

Current educational reforms in African countries emphasize inquiry based instruction and laboratory science which are not contextualized and have no relevance to indigenous people and their everyday activities (Shumba, 1999). Perception that science knowledge can be "transferred" to the education systems of Africa should be revised. Only a self regulated learning process, which considers the situational bindedness of the knowledge between the learner and situation or context makes it possible to create knowledge in different situations that promote students' identifies.

Through colonial impositions, Western-based scientific knowledge, the so-called empirical or positivist knowledge, exclusively isolates African students who are likely to fail to appreciate and recognize their place in the science that they learn. In African classrooms, context-based indigenous

epistemology makes sense to both the teacher and learners who can identify with the learning process and the applicability of the science content (Breidlid, 2009; Shizha, 2008a), and incorporating indigenous perspectives provides a paradigm shift in support of African indigenous people's aspirations and their holistic life experiences.

A Brief on Indigenous African Knowledge and Science

There are many ways of conceptualizing and defining indigenous knowledge since meanings and terminologies are quite varied and based on cultural, social, political and ideological definitions (Shizha, 2008a). All forms of knowledge are grounded in culture and cultural identities. Culture is multi-faceted; it may function as a tool used by dominant groups to oppress and undermine the less powerful, or it may be a resource that people can draw upon to give energy to their lives and identities, or it may be a vital feature of ongoing social interaction (Schissel and Wotherspoon, 2003). Cultures are not abstract phenomena that exist independently of people, but rather are living, dynamic entities that interact with and take shape within daily social circumstances. African indigenous knowledges are embedded in the daily circumstances and experiences of diverse African people in their local communities. Regarding the interface between cultural identity and indigenous knowledge, Catherine Odora Hoppers (2005: 2) observes that it

> is the template shaping values, behaviour and consciousness within a human society from generation to generation. 'Cultural rights' means the right to preserve and enjoy one's cultural identity and development. … Within this template, the notion of indigenous knowledge systems (IKS) has been defined as the sum total of the knowledge and skills which people in a particular geographical area possess.

In addition to Odora Hoppers's observation, Watson-Verran and Turnbull (1995: 116) observe, "Though knowledge systems differ in their epistemologies, methodologies, logics, cognitive structures, or socioeconomic contexts, a

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characteristic that they all share is localness." Localness is a component of local people's culture and indigenous science, in particular. Each epistemology represents an indigenous science or knowledge for a given culture. It is a body of local knowledge and skills unique to a culture, often outside the formal education system that enables communities to survive. Much of African IKS remains tacit, sacred and embedded in practices, relationships and rituals (Bhola, 2002), often transferred orally between generations. Lack of documentation, clear ownership, and development makes it easy to ignore African IKS in favour of Western knowledge systems. Ditton (2007) notes the mono-cultural predominance of Anglo-American-Australian educational approaches to serve the business and capital interests of these countries, which Gonzalez (2004) in Shizha (2008b) describes as 'coloniality of power,' a system of control through globalized politics, economics and culture. Western science found in African educational institutions is embedded in this coloniality of power. There is inequality in the hierarchical placement or positioning of Western science and African indigenous science. Indeed, students are required to master the highly positioned empirical laboratory science that contributes towards established Western 'knowledge,' while being discouraged from broadening their lowly placed cultural science knowledge (Shizha, 2006, 2008a). The colonization of African knowledge spaces by western 'knowledge' in African educational institutions is very problematic. African narratives have been marginalized and deemed irrelevant when in actual fact they are the bedrock of African people`s existentiality and identity. The canon in the current science curriculum in schools represents the grand narrative that privileges the Western-European perspective. In contrast to canonical and mainstream scientific and technological practices, Odora-Hoppers (2000) is convinced that the strategic attempts in Western scholarship gives a negative cognitive and ontological status to everything African while valorising everything in terms of Western cosmology resulting in a monopolising and conformist-driven strategy.

The Essence of Science Education and the Global/Neoliberal Influence

The challenges from globalization rekindle the colonial memories that reify Eurocentric cultural values and predispositions which are considered as scientific or empirical for the official curriculum in Africa (Shizha, 2008b). According to the South African National Science Education Standards:

> Science is a way of knowing that is characterized by empirical criteria, logical argument, and sceptical review. Students should develop an understanding of what science is, what science is not, what science can and cannot do, and how science contributes to culture (South Africa, 1997).

While the South African National Science Education Standards mention science contributing to culture, it is not specific on which culture. What we know is that school science reinforces and reproduces Eurocentric or Western cultural capital, and conversely views indigenous science as "mythical and mystical" despite its applicability to indigenous people's health systems, agricultural production, agro forestry, and biodiversity (Shizha, 2009). In African academic circles, science is taught in "simulated experimental teaching" (Ma and Chen, 2009: 89) which is predominately influenced by Western meanings and emphasizes the importance of data and empirical evidence on which to build theories (Shizha, 2008b, 2009). In African official science curricula, science is defined from a Western perspective as "the acquisition of systematized knowledge in any sphere of life by methods that are based upon objectively verifiable sense experience" (Makhurane, 2000: 64). Western science disregards the people's science or everyday life experiences and focuses on replicable observation, description, prediction, and experimentation related to the physical world (Shizha, 2008a).

A critical contributing factor, which impacts on the dynamics in science knowledge construction, is globalisation (Esland, 1996). Knowledge production cannot be divorced from the cultural perspectives and the seemingly pervasive interaction of global influences. These influences have effects on education and how curriculum is designed. Because

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education is a cultural process, it brings endemic local tensions into the larger global arena. The influence of globalization on science education and education in general cannot be ignored. Globalization, in its neoliberal sense, refers to a series of economic, cultural and political changes typically viewed as increasing interdependence, integration, and interaction between people and organizations throughout the world (Reynolds and Griffith, 2002). At the level of education, this interdependence includes sharing knowledge and the cross-fertilization of ideas that are relevant for the scientific and economic development of nations. Cross-fertilization, or the hybridization of knowledge, takes into account the differences in the socio-cultural needs of local people (Shizha, 2008b). This entails making indigenous knowledges of local people and the so-called 'positive' knowledge part of the scientific knowledge created by the people, especially educators who have the privilege to construct, legitimate and validate science curricula in schools.

School science based on science laboratories, theorization and positive evidence does not "allow for cultural differences" and "science for all" (Brady, 1997: 414). Instead, science education leads to educational disappointments as African students struggle with abstractions that require memorization rather than applicability in everyday life experiences. Euro-American science, in the form of 'global knowledge', is rooted in "the violence of abstraction" (Baber, 2002: 747) and in the "strategic use of positive essentialism" (Spivak, 1988: 4). In contrast, African indigenous science is practical; everyday life is more about learning how to do things rather than passively receiving knowledge. From a traditional African knowledge perspective, learning is a continuous process not institutionalized but conducted as an exercise of dignity and autonomy.

Science Education and Cultural Dissonance in Africa

In African classrooms, educators may have to address the complex challenges in terms of how 'official science' disrupts everyday life experiences and intercultural realities. As change agents, teachers require committed to critically

rethink how they can strategically construct opportunities and spaces to recognise and build on learners' knowledge and experiences (Odora-Hoppers, 2001) and ensure that learners are able to insert themselves into the democratic learning processes (Prakash and Esteva, 1998). As Schostak (2000) argues, there are no grand narratives concerning what is 'good for all'. Standardisation, to create the curriculum as dictated by neoliberal policies, is patently absurd in a context of diversity and culturally creativity. Standardization of subject matter, pedagogy and high-stakes testing are perceived as solutions to the perceived 'crisis' of the failure of African schools to create competent workers. Through the application of capitalist ideology, schools are expected to churn out school leavers with the 'correct' work attitudes and skills for the capitalist system; hence schools are engaged in behavioural and ideological management of learners. Standardisation of any curriculum generally tends to imply that schools exist "in a vacuum hermetically sealed off from the outside" (Brighouse and Woods, 1999: 99). Such a curriculum is more alienating than invitational as it seeks primarily to satisfy the powerful and privileged instead of converging with the needs of learners in their respective personal and social contexts (Odora-Hoppers, 2001).

The culture of a social group includes its distinctive commitment to certain values (Muwanga-Zake, 2009) that are coherent, profound and systemic to the extent that discrepancy in school achievement could be the manifestation of discontinuity between culture at home and the expectations at school. Hence, Ditton (2007) recognises different epistemologies in different contexts, and cultures' while Semali (1999) deplores the rarity of the interface between the school and African indigenous sciences in science classrooms in many post-colonial schools (Semali, 1999). Formal schooling and formal science, a creation of colonization in Africa, dictate that students follow a prescribed curriculum that is standardized (Shizha, 2008a). Standardization means that teachers focus on the subject matter prescribed and predetermined by the State and book publishers. Cultural practices and preferences in terms of individual and intra-individual cultural variation are ignored resulting in the cultural caricaturing of some social groups (Lahire, 2008). The transfer of individual knowledge from the

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learners' everyday life experience to school science lessons is not always valued and encouraged. In the process, African ways of learning and their associated science are not recognized (often deliberately by some teachers (see Shizha, 2007).

Colonially educated teachers create a cultural dissonance between the learners' acquired life experiences and the abstractions of Euro-American science. Neo-colonial education driven by neoliberalism and the credentialization of learning for market-place certification invalidates African sciences to the extent that they are regarded as 'backward' and 'retrogressive.' Julius Nyerere (1968), the first president of Tanzania, once lamented the lack of consistency between school science and learners' indigenous cultures and blamed this dissonance for underdevelopment in Africa. Julius Nyerere (1968: 278), the first president of Tanzania, once lamented

> At present our pupils learn to despise even their own parents because they are old-fashioned and ignorant; there is nothing in our existing educational system which suggests to the pupil that he [she] can learn important things about farming from his [her] elders. The result is that he [she] absorbs beliefs about witchcraft before he [she] goes to school; but does not learn the properties of local grasses; he [she] absorbs taboos from his family but does not learn the methods of making nutritious traditional foods. And from school, he [she] acquires knowledge unrelated to agricultural life. He [she] gets the worst of both systems!

Nyerere recognized the need to integrate school knowledge and home knowledge to make learning relevant to African students in order to disrupt the cultural dissonance that existed in the delivery of formal science knowledge.

Cultural dissonance

Cultural dissonance in this paper refers to the disturbing inconsistency between the African students' cultures and the science curriculum that is taught in African

schools. In extension, it is the dislocation of science learning from the cultural experiences of African students, where science learning has no practical implications for their communities' survival and progress. Students who are competent in their cultural explanations or perspectives of science are regarded as "foolish" because of the negative perceptions and conceptions of indigenous African sciences. According to Heine and Lehman (1997), dissonance destroys self-affirmation that is required to maintain a global image of self-integrity through frequent explanations and rationalization of the self. Self-affirmation bolsters a person's perception of their integrity, moral, adaptive adequacy and confidence (Schmeichel and Vohs, 2009). In African schools, students' self-affirmation is disrupted by the teaching of science that disengages the students from image-maintaining process. Shizha's (2008b) study on the incorporation of indigenous knowedges in science learning in Zimbabwe found that students were silenced by the strangeness of what they were taught and were totally disengaged from the learning process. In Kenya, Cleghorn and Rollnick (2002) observed that students who were taught science in their language and applied the cultural knowledge that they brought into science lessons from home performed actively during science education. Dissonance between 'formal science' and 'informal science' creates a boundary between "cultural legitimacy" and "cultural illegitimacy" (Lahire, 2008: 166). Cultural legitimacy is not a purely arbitrary and empty concept. Rather, it depends in large part on the specific properties of cultural activities, namely whether they are individual or collective, organised or unconfined, formal or informal, tight or loose, contemplative or participative (Lahire, 2008). Positive science is accorded cultural legitimacy by elites to create socio-historical conditions that produce homogeneous cultural profiles with cultural dissonances that disregard the contextual plurality and social functions of culture in science creation, use and interpretation.

Dissonance in science education in Africa can be eliminated by motivating African students to choose alternative learning experiences or explanations and alternative knowledge to what western science regards as "truth" and "rational". Spreading the alternatives, as Heine

and Lehman (1997) suggest, builds a positive image among students and gives them positive personality feedback that promotes cognitive development and learning competence in science. Marginalization of African indigenous sciences alienates students and threatens their confidence and self-affirmation. Spreading alternative learning styles induces high performance motivation and, in that vein, Makuwira (2008) provides a list of what are considered to be characteristics of pedagogies which represent the indigenous worldview in science. Indigenous learners are categorized as:

- Holistic learners – meaning that indigenous students learn in a complete, cooperative, and integrated manner;
- Imaginary learners – where the students' learning environment is unstructured;
- Kinaesthetic learners – where learners learn through manipulation and movement;
- Cooperative learners – where learning emphasizes group interaction rather than individual effort;
- Contextual learners – where the learning takes place in a specific context relevant to the learning; and
- Person-oriented learners – where learning is not information-oriented but person-oriented.

These learning attributes of African indigenous learners should be taken into account in any teaching and learning program designed to enhance students' self-affirmation and self-perceptions in order to promote high performance in science learning. The above categorization can be implemented in science curriculum that is student- and community-centred; a process that utilizes social learning through community projects. This model develops a mind and intellect that builds on the holistic and integrated approach that emphasizes and strengthens students' imaginations and cooperative learning. There is a keen awareness that knowledge production is socially derived and evaluation in the context of this approach is not associated with objective tests but rather with measuring attitudes and social consciousness (Emeagwali, 2003).

When viewed from the neoliberal perspective, one sees a great divide between the expectations of neoliberalism, which promote individualism and competition, and the person-oriented approach linked to indigenous learning strategies. Positive science and learning techniques promoted by neoliberalism encourage homogeneity and promote cultural dissonance in the learning settings. Dissonance is in the form of foreign language, assessment, learning style and the irrelevance of science activity that have a negative impact on students` perceptions and understanding of science. Most African students struggle to establish meaningful knowledge and learning remains an impenetrable domain. The cause of cultural dissonance could be linked to the elite African teachers who shun indigenous African science. Thus, according to Muwanga-Zake (2009), an academic African is assimilated into Western intellectual bondage without concern about growing African IKS, leading Raseroka (2005: 6) to assert:

> African communities generally have a diminished appreciation of IKS. Imperialism successfully implanted the perception that IKS is worthless or shameful because it did not fit into the colonial education system, its scientific notions and/or the missionary worldview (e.g. perception of all traditional healing practices as witch craft resulting in some cases to criminalization of the practice of this form of healing; the demonization of belief in the ancestral spirit world).

Innovations in African Indigenous Science

Sustainable growth and technological development are achievable (Mohand-Said, 2009). To make advances in scientific developments, African scholars and scientists should avoid the absolutization of indigenous knowledge systems of Africa's indigenous people and the perception that western traditions of knowing, which are intolerant to other traditions of knowing, are the best (Ntuli, 1999). Africa was not a *tabula rasa* before the colonial era and western cultural systems of knowledge were not regarded as the means to be used in determining the value of Africa's ideas,

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beliefs and general way of life (Ntuli, 1999). Africa had its own knowledge, ideas and scientific constructs. The colossal architectural Great Pyramids of Egypt and the stone structures of the Great Zimbabwe in Zimbabwe are good examples that reflect the mathematical and scientific principles that were used in constructing these structures. It is therefore crucial that Africa builds on all the valuable indigenous cultural capitals of the past and relinquishes all that is deskilling or disempowering and disastrous to her development, advancement and sustainability. Even today, certain indigenous scientific methods are still in place and in use. For example, the fishing techniques used in East Africa that preserves and conserves fish for future breeding; the post-harvest pest control systems found in most of Africa; and the methods of food preservation and processing are based on African indigenous ways of knowing. Because AIK research is largely community based, a major investment in the enterprise is the well being, health and survival of the most valuable resource of all: people. The use of different herbs and plants to manage disease among the Maasai in Kenya and Tanzania; the *hoodia* plants used by the Sani people of Southern Africa; the discovery of the healing properties of the African willow (South Africa) and the hoodia plant (Namibia) and iboga (Gabon and Cameroon), botanicals which are about to revolutionize the Western medical establishment in terms of cancer treatment, dietary care and anti-addictive therapy, respectively (Emeagwali, 2003) highlight the importance of honouring and respecting African perspectives on science, thus emphasizing the need for an integrated curriculum in schools. Rather than developing an ecologically coded African society which excludes the traditions of knowing of other peoples, an inclusive system and process of traditional knowledge should be deliberately and vigorously sought and implemented in the education system of the continent (Maila and Loubser, 2003). The importance of indigenous sciences was supported by Carlson, Foula, Chinnock et al. (2001) who acknowledged that Shaman Pharmaceuticals in South San Francisco collaborated with 58 traditional doctors from 7 provinces and 42 communities in Guinea, West Africa, between 1994 and 1998, which resulted in a collaborative venture in which 145 plant species were identified as useful for the treatment of

type 2 diabetes mellitus. Guinea's traditional healers' botanical medicines were highly acknowledged and the healers' contributions recognized in their research with Shaman Pharmaceuticals. Guinea can apply this known indigenous science in its schools to promote indigenous knowledge in the competitive global scientific knowledge. These are achievements and knowledge productions that science education in African schools should be based on in addition to Western science. Traditional African medicinal practices and success are only part of the wider knowledge base on which indigenous sciences are constructed. An analysis of indigenous sciences should include, for example, discussions on medicine, mathematics, food processing, metallurgy and building technology.

School science in Africa should focus on redocumenting and reanalysing these scientific developments, some of which were destroyed and discontinued because of colonialism (Shizha, 2006). One way to reengage African indigenous science in education is through integrating African indigenous perspectives and Euro-American perspectives. African indigenous sciences have been very innovative and useful in the cultural context in which they were constructed and applied. Regrettably, much of the conventional positivist and phenomenological literature is silent about the contested nature of knowledge production (Semali, 1999). There is also silence and paucity of literature on the development of scientific knowledge in Africa. Given that personal and cultural beliefs influence perceptions and interpretations of knowledge, Euro-American science has been shielded from penetration by African indigenous science by arguments that focus on lack of evidence and impairment of objectivity that critics employ against African indigenous sciences. Those conducting the assessment and legitimation of science use political and ideological influence or biases and financial power to delegitimize non-western sciences. Since indigenous science seems to be relatively less transferable than conventional science, and given its holistic socio-cultural and even spiritual dimensions, students should relate science to community-based learning and community-based research in terms of discovery and experimentation and the mode of

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transmission and sharing should be collective rather than individualistic.

The Interface

Africans cannot avoid becoming part of what the west has achieved in the world, without forgetting that they, too, have something to offer from their cultures and knowledge (de Beer and Whitlock, 2009). One needs to arrive at a new integration of indigenous knowledges and that of the rest of the world. There are intersections between mainstream science and indigenous science. At the core of mainstream science is the desire to negotiate nature through sequential processes such as hypothesis formulation, experiment and prediction (Shizha, 2006). The process of discovery may be intuitive, accidental, conjectural or inspirational but outcomes are generally predictable and repeatable although some scholars argue that the general thrust of mainstream science is to explain regularity and to deliberately exclude the unique and intractable (Emeagwali, 2003). Stewart-Harawira (2005: 32) observes that

> despite having been devalued, marginalised, disenfranchised and frequently submerged throughout the history of Western imperialism, traditional indigenous knowledge forms have a profound contribution to make towards an alternative ontology for a just global order.

Gergen (2001) argues that knowledge (whether indigenous or western) is spawned within a particular segment of society based on power and class. Aronowitz and Giroux (1985) endorse this view when they argue that schools play a particularly important role in legitimising and producing dominant cultural capital through the hierarchically arranged bodies of school knowledge. In Africa, hegemonic western knowledge continues to be given high status in the school curriculum while disadvantaging indigenous African learners who might have attained indigenous cultural capitals. Integrating African perspectives in science education brings learners closer to their cultural identities and experiences leading to a science that is learner friendly

and meaningful. Many teachers are hesitant to incorporate IK in the classroom out of fear of infecting classroom teaching with 'pseudoscience' (de Beer and Whitlock, 2009).

In some countries, such as South Africa, Ghana and Kenya, there exists profound enthusiasm and deliberate propositions to incorporate and integrate Indigenous Knowledge Systems in education. In South Africa, environmental education provides a vehicle to incorporate Indigenous Knowledge Systems into the school curriculum (O'Donoghue, Masuku, Janse van Rensburg and Ward, 1999). In 1987, the World Commission on Environment and Development advised that society had a lot to learn from traditional skills and knowledge to manage complex ecological systems (Masuku-van Damme, 1997). It is refreshing to note that the South African government has adopted a broad and holistic policy framework for implementing this international resolution (South Africa, 1997). Consequently, indigenous communities and all South Africans are encouraged and called upon to value traditional knowledge and innovations. Furthermore, the National Research Foundation has made Indigenous Knowledge one of its focus areas in collaboration with the Department of Arts, Culture, Science and Technology (South Africa, 1996).

Scholars and educators need to revisit their educational curricula and align them to the needs of Africa based on the available resources at hand. A progressive and robust approach to the transformation of education to address this crucial issue of the disparity in the utilisation of traditional knowledge systems, is critical to the process of emancipating traditional knowledge in both the African and international perspective. Educators, in a collaborative way, may have to strategically rethink the curriculum challenges in terms of how scientific and technological knowledge will be constructed (Scott, 1999). A blended or hybridized curriculum that incorporates Western science and African indigenous science should be the way forward. There are many indigenous knowledge systems that can be integrated into the science curriculum in African schools. Scientists in South Africa are testing many different indigenous plants that seem to have potential for healing illnesses like malaria, TB, and diabetes. Others are being considered for use as

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immune modulators for liver transplant patients (Horn, 2005). In Zimbabwe, Mapara (2009: 146) reports that

> Among the Shona people, when one was suffering from malaria, there was the use of plants like *chiparurangoma* (borreria dibrachiata) as a form of treatment. It was administered orally and one was usually healed of the ailment within twenty-four hours. The Shona also used the shrub called *muvengahonye* (canthium huillense) to treat and heal wounds that had become septic on both human beings and livestock. Other plants like *chikohwa/gavakava* (aloe) were and continue to be used to heal people who are suffering from stomach ailments.

Science topics could include ecological sustainability which requires "a patient and systematic effort to restore and preserve traditional knowledge of the land and its functions… this is, knowledge of specific places and their peculiar traits of soils, microclimate, wildlife, and vegetation, as well as the history and the cultural practices that work in each particular setting" (Orr, 1992: 32). This type of knowledge is vital in most African communities. As an example, the Maasai pastoralists of northern Tanzania and southern Kenya traditionally know where to find water, and green shrubs that can be fed to young calves, even during long periods of drought. Likewise, in Ethiopia, often regarded as inevitably dependent on Western aid, the threat of famine can be overcome by local expertise. As Worede (in Seabrook 1993: 13) explains:

> There is a wild plant that grows on the Somali border, under the driest conditions, less than 200 mm of rain a year… There are other crops; things people have known where to find in distress times. They go to the mountains and pick them and survive somehow. But if you destroy the natural environment of such plants, you lose these resources, and your monocultures won't save you.

By including indigenous knowledge in the curriculum, the particular social identity of the student is acknowledged. By

acknowledging students' particular cultures, science programs can turn learning into a more positive experience for students who are resistant to studying the westernized science curriculum (de Beer and Whitlock, 2009).

The work of indigenous healers is well documented in Africa and their role in science and the health sector can no longer be ignored. Amutabi (2008) observes that in Kenya, little has been written about indigenous medicine and the health practices of alternative healers, but this did not stop the government from incorporating indigenous medical systems into Kenya's health system and successful in its mission of availing medical services to the majority of the people. A study by Njoroge and Bussmann (2006) cited in Wane (2010) among the Kikuyu show how herbs are administered to cure malaria. *Caesalpinia volkensii, Strychnos henningsii, Ajuga remota, Waarbugia ugandensis,* and *Olea europaea* were identified as anti-malarial herbal remedies found in the majority of the medicines obtained from roots, trees and shrubs. This indigenous science is relevant for school science and should be part of the science education in African schools. What kind of knowledge do natural healers have and how different is it from the knowledge taught and researched in Western universities? This question has a determining influence on the way indigenous African knowledge is perceived in the Western countries, and also on how Western knowledge is used in Africa. Thus it is important to understand how indigenous African people relate to a globalized science. Africans cannot avoid becoming part of what the west has achieved in the world, without forgetting that they, too, have something to offer from their cultures and knowledge. Africa needs an integration of indigenous sciences and Western science world.

According to Carter (2004), science learners in developing countries may develop a hybridization of perspectives and multiple identities that include interactive knowledge and epistemologies from both Western science and traditional ecological knowledge. What is currently missing, in most African science classes, is a system of teaching and learning that can combine the two. African children are either kept in their home environments, missing out on the 'modern' aspects of education, or (increasingly)

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forced into full-time formal schooling, missing out on the 'traditional'. The latter often furthers the neo-colonial mentality by building aspirations of urban life and encouraging young people to believe that they have no future in rural communities.

Critical Pedagogy of Place and the Interface

The entrenchment within the curriculum and the educational milieu of structures for the critical evaluation, understanding and revitalization of AIK must necessarily be an important challenge for 21st century policy makers and educators (Emeagwali, 2003). The end result could be the consolidation of self-sustaining networks of local researchers, democratically engaged in research and compatible with community values, aspirations and goals. Place or location is important in the integration of Western science and indigenous science in Africa. A synthesis of the two sciences can be applied through critical pedagogy of place. As a theoretical framework, critical pedagogy of place synthesizes two education traditions, "critical pedagogy" and "place-based education" and has been proposed as a suitable perspective from which to investigate the connections among ecosystems, culture, and education (Gruenewald, 2003). Critical pedagogy challenges the "assumptions that education should mainly support individualistic and nationalistic competition in the global economy and that educational competition of winners and losers is in the best interest of public life in a diverse society" (Gruenewald, 2003: 3). Rather than teaching and assessing student understanding of an abstract, decontextualized science, a critical pedagogy of place "encompasses an explicit understanding of relationships and processes, an embodied knowledge of community relationships and the ecology of place, an awareness of the layered nature of the interdependencies of life-sustaining processes" (Bowers, 2001: 152). To date, comprehensive attention to indigenous African science knowledge, its origins, construction, teaching and learning has remained more artefact than fact.

The fact that science teaching and schooling in general is conducted in a western foreign language makes the discussion on implementing indigenous sciences in African

schools mere cosmetic romanticization. Currently, the official language in most sub-Saharan countries is an imported European language and education policies have excluded the use of indigenous languages beyond early primary school. The educational liabilities of imported language use only policies impacts on poor performance, school drop-out rates, inappropriate and culturally irrelevant materials, and exclusion from participation in national decision making (see Bamgbose, 2000; Bunyi, 1999). Africans have a culture, a history, a way of thinking and doing things that are different but enriching. These attributes are linked to the places we inhabit and the locations we occupy in our society. We communicate, interact, socialise and conceptualise issues from a different perspective, background and experience. We tend to look at the whole for meaning and symbolism. We do not split or operate in a linear pattern of thinking. These could no longer be ignored within the transformation framework. It is this African culture and way of doing things that should be integrated into the science curriculum. Therefore, academic institutions should apply pedagogy of place to bring life to science lessons in their classrooms, science that phenomenologically relates to the African learners' lived experiences.

3. Conclusion

So much is being written and proposed on the viability of indigenous knowledge in Africa and other regions where indigenous people live but the question is: In the face of persistent global and market forces, can indigenous knowledges survive and be utilized in science education in Africa? To what extent can indigenous sciences be integrated into the science curriculum in Africa? The paper has revealed the viability and usefulness of African indigenous sciences in the life of indigenous people. Indigenous science is important in the communities in which it is used as everyday knowledge, which children grow up learning in their communities. For African students, science education that negates their lived experiences and cultural knowledge would perpetuate and reinforce colonial and neocolonial developments that actually disenfranchise them in a world

where multicultural or intercultural knowledge is the basis of most educational projects. Needless to add that I am not calling for the continuation of culture and context deprived systems of education that are not prospectively responding to the needs of a changing world, but rather I support a hybrid of cultures that responds to the needs of African children in African schools. What I am arguing for is the creation of a critically less isolationist science education system that infuses a lot of culture and indigenous paradigms to create inclusive spaces of schooling. Indeed, it is that type of education that can achieve two important, pre-credential items for the child: the desire and the need to be recognized, and the empowerment that is partially instigated by that recognition. If education is a life-long process that is influenced by culture, African indigenous ways of knowing have a role in the learning process in African science education. Science whether in its positive sense or cultural sense is a way of life of a particular people. Western science is not different from African indigenous science; it is also a local knowledge/practice that co-produces a knowledge space. It is essentially a group activity inevitably based in a tradition (the work of others) and it operates, not according to some set of universal principles of logic or method but by local contingent judgements and negotiations which include not just cognitive and practical concerns but moral, political and economic interests as well.

The fact that Africa experienced colonization and is a member of the global community, makes the argument for integration of positive science or colonial-global science and African indigenous science compelling. School science becomes more meaningful if students have voice and see its relevance and experience it outside of school. Teachers and students should contribute to an anti-racist and anti-oppressive educational and social practices, and diverse perspectives from multiple social locations. Therefore, African students should experience a hybridity of positive science and indigenous science, with the latter occupying a larger portion of their cognitive experience. As van Wyk (2002) argues, the reality is that in an expanding globalised world, learners can easily become alienated from what is taught in science, as well as the way it is taught if they are denied their cultural knowledge in science education. If

standardisation is applied to science, the curriculum generally tends to imply that schools exist "... in a vacuum hermetically sealed off from the outside" (Brighouse and Woods, 1999: 99). The assumption that Africa was empty of science and rational knowledge until Europeans arrived is based on a narrow perception of knowledge as a universal resource (Shizha, 2006). Much research in recent years has addressed the contribution of indigenous knowledge to development initiatives in developing countries, thus, proving the important role that indigenous knowledge plays in science education. Only recently have African nations begun to make their way towards establishing genuinely autonomous education systems incorporating elements of indigenous culture. Africa can succeed in implementing indigenous sciences if academics in African schools act proactively and show interest in indigenous research that can facilitate indigenous peoples' struggle against the ravages of colonialism, neoliberalism and globalization (cf. Shizha, 2010).

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