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Editorial: A South–South exchange begins to re-frame historic dialectical exclusions into situated heritage discourses of reflexive re-imagining

Rosa Guadalupe Mendoza-Zuany, Universidad Veracruzana, Mexico, and
Soul Shava, University of South Africa

The environments in which indigenous communities live have been sustained through complex interactions over centuries. Since the advent of colonial modernity, however, these interactions have experienced change and risk. In education for sustainability, these indigenous environments can be read as changing social–ecological landscapes which both sustain diverse livelihood practices and exhibit the escalating challenges of late modernity. This Special Issue of the *Southern African Journal of Environmental Education* (SAJEE) focuses on the intergenerational knowledge and livelihood practices of indigenous communities who – often marginalised and facing ever-narrowing prospects of future sustainability – are confronted with an education system that is a relic of colonial modernity and devoid of any social-ecological heritage to which they can relate.

Environmental educators and researchers are therefore asking questions concerning colonial modernity in current educational practices, such as:

- What can be done to address the predominantly reified and disembedded curricula offered in school and post-school contexts today?
- What is the value of bringing local, indigenous and intergenerational heritage and knowledge practices into the curriculum?
- How can this inclusion be done in pluralistic and intercultural ways?

It is precisely these themes and topics that are addressed in this Special Issue's research, viewpoint and think-piece papers. Many of the contributions have emerged from an international collaboration around Education for Sustainable Development (ESD) through the ESD Expert.Net programme.[1] This has involved exchange visits between South Africa, Mexico and India, which have produced research collaborations and contact with researchers from further afield – in Zimbabwe, Zambia, Australia and Norway – who responded to the call for papers. There is clearly a strong interest within the international academic community to explore the relevance of indigenous knowledge, in research and in education, in order to better direct human activities towards a sustainable future.

Some key thematic aspects from the papers are:

- Indigenous environmental knowledges, sustainable livelihood practices and resilience in socio–ecological contexts;
- Situated intergenerational and intercultural indigenous knowledge heritage;

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- The education of indigenous people at school, and at undergraduate and graduate levels;
- Indigenous environmental knowledge in transformative formal education contexts;
- Indigenous environmental knowledge, epistemological access and knowledge plurality in formal science education in relation to ESD; and
- Cutting across these, the themes of plurality, epistemological access, legitimation, resilience and sustainability.

As the guest editors of the Special Issue – from the Universidad Veracruzana in Mexico and the University of South Africa (UNISA), South Africa – we found that the South–South dialogue reveals common challenges, as well as many shared values. In both our contexts, scholars writing on heritage and indigenous knowledge value the high cultural and biological diversity in their countries of origin. The papers reflect the researchers' motivation to explore the inclusion of indigenous knowledge heritage and practices within formal and informal learning interactions across the schooling, university and community contexts of ESD.

Across the authors' diverse socio-cultural and ecological contexts, there is agreement that indigenous knowledges are bodies of intergenerational knowledge that have emerged in, and are sustained by, indigenous populations in a particular territory through their interactions with their lived environment. These knowledges are embedded in memory and embodied in the peoples' cultures and practices in these territories. Such knowledge is expressed and shared – mainly orally – through stories, songs, dances, myths, values, rituals, community laws, local languages, taxonomies and agricultural practices, amongst others. These knowledges are also cumulative, representing many generations of experience as the result of experiments and innovations that have shaped cultural dispositions and practices over thousands of years. They are a collective wisdom that continues to emerge in response to local problems and conditions specific to a lived environment. It is thus not surprising that there has been a sustained scholarly interest in indigenous knowledges over the years, with both scientists and educators exploring their relevance for understanding and addressing current sustainability issues.

The researchers also agree that, while the decision to incorporate indigenous knowledge into current education and research practices is an academic one, it is also political. Such a decision challenges the academy and the sciences with the questions and the answers that indigenous knowledge raises about the nature of our existence, our conscience and the way in which we produce and represent knowledge.

As collaborators from the Global South in countries colonised by Eurocentric and modernist thought, we recognise that the epistemologies and theories produced in the Global North have influenced our ways of thinking, our sciences, our beliefs and our conceptions of life and the world and, therefore, the way we collaborate with others. Historical influences and patterns of exclusion have contributed to risky asymmetric conditions and unfair relationships that commonly devalue knowledge that is not generated within western academic canons and sciences. Questioning and challenging the status quo permits new positions and more inclusive opportunities to emerge, and help us make visible the richness and epistemological diversity of situated intergenerational knowledge that has been obscured by the dominant forms of colonial and modernist abjection. This Special Issue contributes strongly on all these aspects.

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A South–South exchange begins to re-frame historic dialectical exclusions into situated heritage discourses of reflexive re-imagining

The papers in this issue deepen our insight into colonial exclusion and the historical marginalisation of indigenous knowledge heritage. In Latin America, concern has been centred on interculturality in education. The papers in this Special Issue thus consider both the inclusion of intergenerational heritage and interculturality in education. This is particularly significant in the context of the global challenges reflected as the 17 Sustainable Development Goals (SDGs) in the *Global Goals of Education 2030* (Brussels Declaration, 2018), which all of the current nation states have ratified.

If we are to achieve the goal of sustainable development for all, educators will need a deeper understanding of how the marginalisation of indigenous peoples and cultural plurality in colonial modernity is still with us as a challenge today. At a seminar on indigenous knowledge at the UNISA Centre for African Renaissance Studies, then director, Shadreck Ghuto, challenged the audience to address the problem of relevance in southern African initiatives in ESD. Informed by colleagues' encounters with intercultural work across indigenous knowledge and the modern sciences in Veracruz, Mexico, the opening paper on 'Navigating non-sense' (O'Donoghue, Kibuka-Sebitosi, Tshiningayamwe & Palmer) opens up the challenge of transcending past exclusions and highlights the role of heritage in meaningful learning at school. It sets the scene for a series of contributions on indigenous knowledge practices (Aparicio; Sandoval-Rivera; O'Donoghue, Sandoval-Rivera & Payyappallimana; Shava & Masuku; Mendoza-Zuany). These research papers illustrate the depth of indigenous knowledge, which has been uncovered and recovered through research on indigenous knowledge systems over the last few decades. They reflect an engagement with the marginalising effects of colonial history so as to reposition 'indigenous knowledge' as a body of knowledge in its own right and as a counterpoint to the hegemonic dominance of the western sciences of colonial modernity. They illustrate how research on indigenous knowledges has opened the door on an expanding role for indigenous heritage knowledge in education.

The above discourses extend into a set of papers that probe exclusion, epistemological questions and legitimation, comprising contributions from Australian, South American and African scholars (Ryan & Ferreira; García-Campos; Ngcoza). These papers provide a vantage point from which to explore the challenges of including heritage as a foundation for learning and change in relation to emerging environment and sustainability concerns.

The work on social-ecological landscapes of change (O'Donoghue, Sandoval-Rivera & Payyappallimana, with short case studies from Mexico, Zambia, South Africa, India and Sweden) first developed as a South–South collaboration that has been extended to include an example from the Global North. The Think Piece (Pesanayi, O'Donoghue & Shava) illustrates research that transcends narrow western ecological idealism, which has driven a wedge between nature and culture. The papers carefully navigate the tendency to portray indigenous peoples as custodians of nature in order to avoid setting them up as different and as a source of restorative hope. The social-ecological research also avoids the intellectual trap of appropriating indigenous knowledge into a reified intellectual discourse or of creating situations where the modern sciences act as a 'mediating doorman'. Experience in compiling this Special Issue suggests that the decontextualised intellectualisation of indigenous knowledge in education only serves limited analytical purposes. Rather, the knowledges must be viewed and represented from

within the natural contexts in which they are located, namely, intergenerational learning, knowledge exchange and reflexive action.

Engaging the complex contours of indigenous knowledge discourses exposes some fractured – and thus difficult to navigate – narratives of idealising opposition. Many of the indigenous knowledge research agendas are maturing within dialectical trajectories of 'indigenous versus western' that are already somewhat locked in. The challenges of re-integration – where indigenous knowledge practices provide heritage foundations for learning across intergenerational capital and where modern scientific institutions provide new environmental knowledge – are raised in two papers (Maldonado, Cruz, Bello & González; and Ndlovu), which discuss inclusive learning in the sciences. Another paper (Mandikonza) enriches and expands the interweaving threads that have become apparent in the course of this contemporary scoping of indigenous knowledge and intercultural meaning-making in education.

The Special Issue contains research by 25 authors from nine countries around the globe, but mainly from the Global South. Overall, the papers that have emerged – from collaborative exchanges and the open call for papers that followed – reflect a formative, diversifying and maturing of indigenous knowledge and interculturality that appears to be both gaining traction and opening up an expanding and more integrated research agenda that is:

- Making the scope and scale of historical marginalisation in colonial modernity more tangible and explicit for informing continuing research;
- Informed by a more nuanced understanding of the challenges inherent in including indigenous heritage knowledge for reflexive relevance in relation to current environment and sustainability concerns; and
- Surfacing the need for realist epistemic theory in education to (1) inform research across diverse knowledge systems and (2) engage with current environment and sustainability concerns.

All of the papers in this Special Edition reflect a necessary critical engagement across heritage and the present-day concerns about sustainability challenges in lived environments. This is clearly an important focus for any curriculum work attempting to realise the *Global Goals of Education 2030*. Here, continuing research into indigenous knowledge practices and systems will hopefully transcend the oppositional struggles between western and indigenous epistemes of the past and redirect the dialectic towards a new era of intercultural and pluri-epistemic co-engagement on heritage, context and future sustainability.

Endnote

1.   See http://www.esd-expert.net/home.html

Acknowledgement

Tribute to Tich Pesanayi

This Special Edition is dedicated to the memory of Dr Victor Tichaona (Tich) Pesanayi (7/12/1965–16/04/2019), who contributed to this Special Issue shortly before his untimely passing. Dr Pesanayi actively contributed to the field of environmental education in southern Africa in many ways, including by serving as Project Manager for Environment Africa, Programme Manager for the SADC Regional Environmental Education Programme (SADC-REEP) and as Council Member for the Environmental Education Association of Southern Africa. Through this work, he has touched and transformed many lives with his gentleness, kindness and commitment to education and training. Tich's research interests were in the traditional agro-ecological knowledge and practices of small-holder farmers in southern Africa, and their transformative role towards attaining sustainable agriculture.

Navigating non-sense by exemplifying situated life experience and intergenerational heritage knowledge in Education for Sustainable Development learning spaces

Rob O'Donoghue, Rhodes University, South Africa; Esther Kibuka-Sebitosi, University of South Africa; Sirkka Tshiningayamwe, International University of Management, Namibia; and Carl Palmer, Centre for Scientific and Industrial Research, South Africa

The method which people use in acquiring knowledge is functionally interdependent with, and thus inseparable from, the substance of the knowledge they possess, and especially from their basic image of the world. If this image is different, the method they devise for acquiring knowledge is, as a matter of course, different too. *(Elias, 1978:64)*

Abstract

This paper uses an activity system perspective to probe the related problems of knowledge abstraction and a lack of relevance as a modern legacy of colonial education practices in Africa. Its purpose is to contemplate Education for Sustainable Development (ESD) pedagogy to support learning that might be better situated in and resonate with local African contexts and the emerging sustainability concerns in everyday life. Colonial education trajectories and the recent inclusion of new environmental knowledge in African curriculum and civic learning contexts are examined. This points to how circulating environment and sustainability knowledge is being constituted in disciplinary fields as abstract concepts that are often difficult to relate to local sustainability concerns. Socio-cultural heritage and intergenerational meaning making are explored to uncover better situated ways of navigating much of the abstract 'non-sense' confronting African learners in many modern education contexts today. Illustrative examples of historical patterns of exclusion are scoped and two cases of pedagogical innovation are examined to contemplate how to navigate better situated and more relevant learning processes. Enacted in situated and co-engaged ways, ESD practices may enable the socio-cultural capital and environmental realities of local social-ecological contexts to articulate with better situated sustainability propositions for transitioning to more peaceful, just and sustainable futures.

Background

In response to a provocative comment by Professor Shadrack Gutto of the Institute for African Renaissance Studies, University of South Africa (UNISA) on the persistent 'non-sense'[1] in much modern environment and sustainability discourse, it was noted that if it weren't for non-sense in the world, there wouldn't be a need to contemplate learning spaces for mediating Education for Sustainable Development (ESD). In this paper, we examine how the problem of 'non-sense' exemplified by Gutto has commonly come to African learners as ESD in

abstract propositions (reified and disembedded perspectives) such as biodiversity and climate change that are difficult to relate to the intergenerational lived experience as felt sustainability concerns of the day.

Climate change is perhaps the most pertinent area of contemporary ESD where the propositions put forward and the risks outlined present as abstractions that are not easily related to context and material practices. New environmental knowledge on climate has circulated, for example, in global imperatives for humanity to learn to live differently so as to mitigate impending climate change (IPCC, 2014). These imperatives for humans to change are emerging around increasing climatic variation and extreme events reflected in higher seasonal temperatures in southern and central Africa, for example. This pattern of human–induced change is producing a widening disruption of some of the stable seasonal cycles that have characterised central Africa in the past and a prediction of widening seasonal variation in areas such as in the Eastern Cape of South Africa that have always been characterised by high seasonal variability. A pressing 'fear-factor' in relation to climate change is currently exemplified in projections of global warming, deeper cycles of drought and more extreme events that are now being communicated to us through the earth and sustainability sciences by climate scientists (Jones, 2016). The scientific work is still characterised by generally poor predictions of how the seasonal cycles will play out each year (e.g. Engelbrecht, Landman, Graham & McLean, 2016; Landman & Beraki, 2012). The global models increasingly forecast a warmer, more dangerous climate for the globe as a whole and retrospective local data and historical records are clearly showing increasingly disruptive events and patters of change that are now being experienced in communities across the southern African region.

Deepening educational challenges in the ESD Global Action Programme

The emergence of climate change data and intergenerational experiences of change has led to calls for ESD as a widening strategy for mediating ethics–led learning and cultural change on a planetary scale (O'Donoghue, 2014). As climate change developed as a global concern, the Global Action Programme (GAP) (UNESCO, 2014) emerged as education activities to be enacted in the coming years. Alongside this and following the relative failure of the Millennium Development Goals, a surprising global consensus was finally achieved on 17 Sustainable Development Goals (SDGs) (UNESCO, 2015) and these were signed by all member states as an agenda for future sustainability with social–ecological justice.

The SDGs gave momentum to the five priorities of the GAP and organisations all over the world have made GAP commitments to work on the following ESD priority areas:

- Advancing Policy: Mainstreaming ESD in both education and sustainable development policies, to create an enabling environment for ESD and to bring about systemic change
- Transforming learning and training environments: Integrate sustainability principles into education and training settings
- Building capacities of educators and trainers: Increase the capacities of educators and trainers to more effectively deliver ESD

- Empowering and mobilising youth: Multiply ESD actions amongst youth
- Accelerating sustainable solutions at a local level: At community level, scale up ESD programmes and multi-stakeholder ESD networks. *(UNESCO, 2014:14)*

ESD policy in Africa has been slow to emerge and clear answers to how education, teachers and training need to be transformed are not always readily apparent. The priority of youth engagement and local change to be enacted in the failing states of Africa also present as insurmountable challenges that are rife with contradictions. These uncertainties and ambiguities are emerging in attempts to mainstream ESD in the school curriculum and to engage youth and communities in change, as discussed in following sections of this paper.

A methodological note

Education is approached as a colonial and modernist activity system in southern Africa that, for the student, comes into existence alongside the experiential and knowledge capital acquired in modern daily life. Here the learning subjects (children as students), why they learn and what they learn are important if we are to get a better grasp of a situated historicity of schooling as a modern activity with inherent tensions and contradictions that may be shaping barriers to learning and change. This study thus approaches education as an emergent activity system for enabling learning and change. Its intent is to uncover and trace some of the inherent axes of tension and contradictions within the system in southern Africa today in order to determine what might be done to enhance learning-led change in a changing world.

The review process

The paper drills down into colonial histories of imperial domination and the modernist globalising trajectories that flowed from these. It examines how these processes have shaped patterns of knowledge production and education practices where cosmopolitan abjection continues to marginalise and exclude (Popkewitz, 2008). These challenges make it difficult for many citizen learners to navigate the complexities and risk of the day in relation to the current global priorities of social justice, globalising risk and future sustainability mapped out in the SDGs.

   The history of colonial and modernist abjection in Africa points to how scholars, youth and communities are commonly confronted by descriptions of risk and propositions for future sustainability that are difficult to articulate with their experiences. The paper points to the need to address these problems of relevance through a restorative concern for situated, intergenerational processes of teaching and learning. A better situated (intergenerational and contextual) approach will require closer work within socio-cultural case histories, situated perspectives, lived experience, local metaphor and intergenerational knowledge practices (endogenous[2] onto-ethico-epistemic[3] processes) (Sandoval Rivera, 2017). In this way, African contexts and cultural capital will need to be more central in ESD if we are to have any chance of mediating ethics-led change to rebalance the social-ecological and political dynamics of the tiny blue planet that is now shared by an expansive humanity which originated in Africa.

Uncovering origins of disembedded non-sense in modern education

Not unlike elsewhere, the school curriculum in South Africa functions as a process that privileges circulating abstractions as powerful knowledge that, once mastered, can empower learners with deepening insights in relation to the workings of the world. Odora-Hoppers (2002a) has noted that, in a modern education system, the situated substance of knowledge in the science curriculum can routinely go unrecognised by young African students. She traces the root of this contemporary problem to how colonial education systems developed as a process that involved 'the overcoming or eradication of "traditions" which were automatically posited as "obstacles" and "irrationalities"' (2002b:20).

These patterns of marginalising exclusion developed out of a history of colonial and, later, modernist dominion through education. In early anthropological research, for example, much of the irrationality of indigenous peoples (natives) was ascribed to 'magic conceptions of nature' as an obstacle to learning European ways (Junod, 1920). Here the underlying assumption of colonial dominion through education was that: 'Whatever the future may be, there is no doubt that for the present the white race has to rule and guide the black race' (Junod, 1920:76). Here the supposition was that:

> Education, scientific training, higher moral and religious conceptions have delivered most of the Europeans from magic. The same will certainly happen to the Bantus if they submit themselves to the teaching brought to them by us, and there is no doubt that there is amongst them an ever-growing desire of obtaining instruction. *(1920:85)*

From these roots and in this way, colonial education history appears to have contributed to the current curriculum paradox that embodied heritage knowledge has receded and situated, intergenerational (indigenous) life experience is seldom integral to learning at school. Here, it is possible to posit that most students were seldom engaged in situating and adequately using heritage knowledge practices and intergenerational life experiences in making sense of modern curriculum propositions. Abstract concepts thus commonly reside outside deliberative experience and can remain unrecognised as clearly relating to local concerns. Environmental knowledge as circulating abstractions to inform our current grasp of environment and sustainability concerns are thus commonly inaccessible in schools where many African scholars are confronted by scientific knowledge that still primarily presents as facts to be memorised. Histories of exclusion and institutional cultures of rote memorisation persist as pedagogical challenges for ESD in many African settings today.

These curriculum challenges of abstraction, relevance, translation and re-contextualisation are also common in modern school settings around the world. The problem is simply more acute in the colonial modernity of the Global South, particularly in Africa, where work with circulating knowledge in education is still not adequately related to, or derived from, a functional articulation with existing intergenerational knowledge and ways of seeing the world.

Circulating reference from inside–out and back

Bruno Latour (1999) sheds some light on how the circulating knowledge production processes in the sciences and the use of 'time-saving abstractions' have contributed to this curriculum paradox. He traces how scientific knowledge on soils in a transition zone in the Amazon came to be constituted across successive periods of fieldwork in Amazonia undertaken in conjunction with work in a soil laboratory in France. Examining these knowledge production processes using his approach to science studies, he reveals how modern scientific knowledge on Amazonian habitats came to be constituted within circular dialogical processes of careful field measurements and sampling. He notes how these processes of circulating dialogical analysis animated the phenomenon and processes in/of the region and how 'time-saving abstractions' emerged to constitute the concepts (articulating knowledge) that were then taken into scientific narratives primarily out of the western research literature and into the region so as to explain things and, through this, to identify and engage emerging problems.

Appropriation and externalisation in circulating knowledge

Colonial scientists working in this way with the habitats and peoples of Africa came to constitute much of the scientific knowledge on African social-ecological landscapes. Shava (2008) examines how much of the environmental knowledge in the sciences, for example, included knowledge capital appropriated from indigenous peoples and their knowledge practices. As this knowledge has come back to us in scientific disciplines and curricula the 'Africanness' is not easily recognised and identified with (Odora-Hoppers, 2002b). Identifying with environmental knowledge is becoming more and more important for succeeding generations if we are to develop better ways of knowing and doing things in the world today.

Blind spots in the circulating externalisation of knowledge

Here it is important to note how the metaphorical reasoning used to represent African knowledge was commonly epiphenomenal in fieldwork but that the 'time-saving abstractions' were commonly constituted from the cultural register of Europe. For example, when colonial scientists were confronted by the teaming herds of African ungulates, they began to develop the modern science of ecology as a field that explained the patterns of interdependence amongst animals and their biophysical surroundings. The social-ecological interactions shaping the distribution and abundance of Africa's biota escaped them (Pesanayi, O'Donoghe & Shava, 2019), and they came to narrate the tragedy of the commons (Hardin, 1968) as a social problem of unawareness and not as an outcome of colonial imperialism. In Africa, the tragedy of the commons was deployed as a political commentary for maintaining separate lands for wildlife (as well as for colonial exploitation) and this became the foundation of early conservation and environmental education. In this way the process was underpinned by education imperatives to tame the destructive hunting dispositions and to reverse communal land degradation evident amongst the rural indigenous peoples (O'Donoghue, 1997).

Inter-cultural misunderstandings abounded in processes such as this. For example, when earlier colonists asked the Xhosa to explain their *umqombothi,* indigenous people described how it was made by fermenting sorghum. Their descriptions were read and translated as 'African

beer' and not as a grain-fermented drink for ancestral ceremonies. In the epiphenomenal transactions, participants did not note that *umqombothi* was an ancestral process which was centred on fermented sorghum and that the same fermentation practices were used to make *maRewu* (a nutritious sorghum energy drink*),* soured porridge and other foods. Also lost to the appropriating conversation were the intricacies of 'crack fermenting'[4] to reduce bitterness (phytates) that enable better nutrient release in African grains, which have lower nutrient content than other global grains. In colonial times, rural natives were not only branded as ignorant and unaware, but as drunkards to boot.

The return of the abstract proposition with explanatory power

In the science curriculum today, nature conservation is taught as a science to manage wildlife in protected areas and to restore biodiversity to degraded rural landscapes. Fermentation is taught as scientific facts, with *umqombothi* routinely used as a local example of alcoholic fermentation. The concept of fermentation is attributed to famous western scientists like Louis Pasteur, who used a microscope to identify bacteria and to explain fermentation. The early discovery was followed by other western scientists who integrated the concept into the field of school science that we have today. In this way, the abstraction was used to identify what, in the western register, *umqonbothi* was (beer) and to correctly point to this product as an outcome of a scientific process of alcoholic fermentation. We now know that phytate reduction to release nutrients and minerals and to synthesise digestive enzymes happens earlier in fermentation processes before the food becomes an alcoholic beverage and how reductive fermentation optimises the availability of nutrients in African grains like sorghum and millet.

As the knowledge circulated in and out of Africa, time-saving abstractions were externalised and assembled around primarily western metaphors and dispositions until these developed into generalisations (concepts) that, when grasped, offer increasing predictive and explanatory power. The concepts then came to be ordered into bodies of knowledge to be taught in the science curriculum today. Here little or nothing could be read as coming from Africa as the appropriated knowledge in relation to African cultural practices was process-reduced into abstract propositions now coming in from the outside and difficult to relate to African knowledge practices. The abstract propositions related to fermentation and biodiversity are simply taught in the modern curriculum as the discoveries of European science, concepts for students to remember as scientific facts and to relate to local examples. Currently, these serve to explain how wildlife needs to be conserved and that *umqombothi* is a fermented alcoholic drink. The attendant disjunctures make it difficult for African students to see the relevance of what they are being taught and their learning is often reduced to remembering what is necessary for them to be successful at school.

Contemplating things turned around the other way

For illustrative purposes it may be useful to ask, 'Had the colonial scientists been Africans who worked out of laboratories in Africa, would it have been the children of Europe who struggled to relate to the time-saving abstractions?' The reversal here serves to point to how the political economy and reductive metaphor can both enable and disable meaning-making at differing ends of the circulating reference in scientific knowledge.

An outcome of colonial education exclusions led to little or no situated articulation of the curriculum knowledge with the lived world contexts of intergenerational daily life in Africa. As mentioned earlier, the challenges of identifying with abstract concepts is a challenge in relation to scientific and mathematical knowledge, for example. Here Sfard (2006:25), points to how, in attempting to understand learning, 'one needs to keep an eye on *the activity of identifying* that accompanies, informs and results from processes of learning' (emphasis added).

This summation derives from evidence of the failures of students to make meaning of mathematical abstractions owing to a process of 'ontological collapse'. Sfard describes how the process of objectification in knowledge creation takes place as actions and events are reproduced as statements through two intellectual moves, the first being 'reification' and the second, following this, a process of 'alienation'. The first is a process of transfer that, she explains, 'consists in replacing talk about actions, with talk about objects'. She notes how the process of alienation that follows involves 'presenting phenomenon in an impersonal way, as if they were occurring of themselves, without the participation of human beings' (2006:24). This analysis loosely resonates with that of Latour (1999), pointing to how decontextualising abstraction accompanied by the exclusion of contextual intergenerational capital in pedagogy might shape environmental knowledge on climate change as inaccessible non-sense that is difficult to relate to and accommodate.

The decontextualised learner in African contexts today

Herein lies a problem of much of the non-sense for African learners today, who are confronted with the challenge of a modernist ESD agenda that does not always afford sufficient contextual capital for meaning-making. Boughey and McKenna (2015), auditing higher education in South Africa, examine some of the modern curriculum challenges associated with the construction of 'the decontextualised learner'. They note how learners are confronted by learning challenges related to language and abstract theory that have little socio-cultural and historical resonance. They thus propose an enrichment of the 'theoretical stockpot' (2015:11), where education practices are transformed to strengthen situated learning and enhance epistemic access into meaning-making with the explanatory power that comes with a functional interdependence and resonance between abstract models of process and situated intergenerational knowledge practices.

The successive crises of failure in colonial African education and in the modern contexts of education in Africa testify to a complex of linguistic, socio-cultural and political factors inhibiting learning and change. Elaborating these further must remain beyond the scope of this paper, where we have restricted ourselves to simple illustrating some of the outcomes of an imperial colonial production of knowledge constituting barriers to learners identifying with much of abstract environment and sustainability knowledge that one still finds in modern education in Africa today.

Faced with the difficulties that many students have experienced when it comes to identifying with the externalised abstractions of environment and sustainability knowledge, educators, primarily in the sciences, have been working with the idea of pedagogical content knowledge (PCK) after Shulman (1986). In simple terms, this approach has played out in

increasing work with analogous illustrations of scientific concepts, creating a whole new arena of circulating metaphor for accessing abstract propositions and their explanatory power. This work is still to give attention to African metaphor, situated experience and heritage in ways that might activate and articulate with intergenerational epistemic processes. Richie (2013) outlines how this is being done in New Zealand through indigenous onto-epistemologies and pedagogies of care with young school children. Working in southern Africa, Maqwelane (2011) examines how a situated pedagogy of care using indigenous knowledge (IK) communicated by *Gogos* (wise grandmothers) enhanced the relevance of the school curriculum and strengthened literacy performance amongst children in a school context in rural Eastern Cape. Education imperatives for articulating intergenerational indigenous meanings and meaning-making processes with modern world knowledge, such as these, are emerging in social movements to introduce African environment and sustainability concerns in the school curriculum and in climate change work with youth on ESD imperatives of learning-led change, both discussed in the sections that follow.

ESD in the school curriculum and the challenge of school reform

As environment and sustainability concerns have emerged in late modernity, there have been a proliferation of social movements working on change in, and the reform of, the school curriculum. Notable here is the ESD Expert.Net collaboration that produced training materials that have contributed to the South African Fundisa-for-Change teacher professional development programme. These collaborations are shaping conceptions of ESD that are proliferating in widening UNESCO-GAP commitments to address the globalising social–ecological and sustainability concerns of the day.

Pedagogical challenges associated with the modern curriculum have proliferated as important bodies of new environmental knowledge, for example ecology, have been developed to uncover emerging environmental problems such as the loss of biodiversity. In the earth sciences, one also finds climate change and earth systems science emerging as key concerns for the survival of humanity into the Anthropocene. These processes have shaped ESD Expert.Net and Fundisa-for-Change imperatives to educate for future sustainability through environmental education and ESD, giving impetus to social movements to engage with these new concerns as a curriculum for future sustainability.

Disjunctures in outside-in knowledge and curriculum innovation

Early environmental education attempted to bring conservation concerns into the curriculum in South Africa as well as to take young children out for encounter experiences in natural settings. Working from outside formal education, the emerging fields of environmental education and ESD developed along with new content and models of process for transforming the school curriculum and education practice. As environment and sustainability concerns became more pervasive and the risk escalated to a global level, more and more new environmental knowledge was introduced into the school curriculum in a failing postcolonial education system. Here the curriculum topics still have the problem that, in Africa, the new

knowledge was not only foreign to the teachers, but it was also not commonly articulated with intergenerational knowledge and seldom reflected metaphorical cues which resonate with African cultural history. The underlying metaphor in ecology and biodiversity derives from the colonial ideal of an African Eden of diverse species and develops as an evolutionary and genetic narrative that implicates the rural African peoples in the modern degradation of the commons. Added to this, few African learners have first-hand experience of the wonders of the wildlife areas that are primarily the playground of rich visiting tourists. There is little or no functional interdependence with which African learners might engage the loss of biodiversity as an intergenerational concern, and degraded rural habitats are commonly read as an enduring characteristic of the African postcolonial landscape.

Fundisa for Change

These challenges are notable from 1994, the year that signalled the end of apartheid in South Africa and the framing of a new outcomes-based education (OBE) system. The curriculum change that emerged and the successive adjustments that followed – the National Curriculum Statement (NCS) and now the Curriculum and Assessment Policy Statement (CAPS) – were accompanied by the inclusion of environmental education as a cross-cutting concern; and one now finds new environmental knowledge included as an integral part of many subject areas. This brought the challenge of training teachers working with new environmental knowledge in school subjects to actualise a meaningful and situated engagement of learners in environmental and sustainability concerns. The Fundisa for Change programme was established by a consortium of universities to provide course-supported training to activate environmental learning around the new environmental knowledge that most teachers had not before encountered in their schooling or professional careers.

Over time, we have noted that by giving attention to the new environmental knowledge that teachers have to learn and to teach, we may not yet have given sufficient attention to how new environmental knowledge is situated in Africa and is articulated in relation with the lived experience of students. For example, how is the new ecological knowledge on biodiversity loss articulated with intergenerational learning in, about and for the social-ecological landscapes of African contexts and everyday life? Given these and other common omissions, it is not surprising that young African students can find it difficult to relate to the many global environmental concerns in their local context and in terms of the ecological, social, economic and political complexities that constitute their daily lives. Here environmental and sustainability education can present as complex, irrelevant and even oppressive processes without a knowledgeable, skilled and empathetic teacher working in collaboration with the concerns of African youth.

ESD in youth and community learning contexts

The youth 'population bulge' in Africa has the potential advantage of becoming a young populace that is energetic and increasingly educated. The adult literacy rates show sub-Saharan Africa at 65% (UNESCO-UIS, 2017) and this is likely to increase. Here literacy is reviewed as

the ability to read and write, with understanding, a short, simple statement about one's everyday life (UN, 2017). The emerging youth problem is one in which more literate but unemployed young people are confronted by an ambivalence in relation to where they come from and who they are. These uncertainties can be accompanied by modern attitudes of entitlement and the immediacy of an 'I want it now' culture in youth, who can increasingly be described as 'techno kids'. The African youth bulge thus presents a contrasting mix of opportunities and challenges.

Youth in a struggle with a foreign education system

Some of the intractable challenges facing an expanding African youth are reflected in an education system where much of what they encounter is nonsensical and irrelevant in many ways. The education system was designed around the need for labour for colonial modernisation in Africa. Following independence, the problematic gap between education and industry widened. This is not a simple matter, deeply rooted as it is in a development paradigm now transitioning into a green economy for future sustainability. Faced with a lack of jobs, hammered by HIV/AIDS, globalisation culture and products, youth with little prospect of work are, in recessionary times, demanding free education and access to their share of economic resources. In South Africa, the increasing cost of education has led to the #FeesMustFall campaign that started in 2015 in a system where the equalisation of opportunities continues to be a problem. Here colonial education perspectives reach into the present from the Bantu Education of apartheid times when most current teachers were educated. The gaps in their knowledge and a narrow pedagogy of the teaching for, and the testing of, memorisation still impact on the quality of teaching and learning in the classroom.

The challenge of transitioning to and through ESD

It is in this challenging educational environment in South Africa that ESD has emerged, with the purpose of enabling youth to take an active part in transitioning to sustainability by entering life-long learning, enhancing social cohesion and realising future sustainability. Some of the major competencies specified for these processes of change include, but are not limited to:

- Promoting the ability to act and make decisions.
- Raising environmental awareness.
- Thinking about different scenarios or alternatives to a situation or problem at a local and global scale.
- Fostering a sense of belonging to the environment.
- Promoting a critical analysis of some phenomenon or subject and
- Positioning one's self to argue for and respect different points of view.
  (Cebrián & Junyent, 2015:7)

These goals require new pedagogies such as peer-to-peer social learning, group assignments and online learning interactions. The problem is that the teachers are not well equipped in these areas and few relate to modern youth culture, which has embraced blogging, Twitter and Facebook as ESD learning tools.

The search for relevance in a globalising world

The subjugation of African intergenerational heritage practices and life experiences has come to haunt the current generations as few youth value, and some even disavow, indigenous knowledge over the new more globalised culture emanating primarily from the West. Not only do the youth adopt new dress, music and language, they also ascribe to dispositions that do not necessarily affirm their African identity.

Towards new communities in learning

More and more youth commonly use technology; some have created their own communities of learning, which are mainly online. These are framed as communities of inquiry (CoI) by Garrison, Anderson and Archer (2000), who observe that online communities comprise a social presence, a teaching presence and a cognitive presence. They note how the communities' goals are primarily concerned with: (i) remembering – the ability to reproduce or recognise the presented material; and (ii) understanding – the ability to construct a coherent mental representation.

CoIs have a learner-centred disposition where multimedia is used to aid human cognition. These approaches contrast with traditional African ways of teaching, namely oral storytelling and learning by doing. The variety of learning methods here opens up the possibility of working with heritage knowledge as a means of encouraging modern youth to contemplate future sustainability via multimedia (Sandoval Rivera, 2015). In this way, they could potentially create relevant concepts and knowledge that is applicable in their lives. Using new forms of collaboration and partnerships in learning appears to be a useful approach for supporting youth to navigate and make sense out of much of the non-sense in education (Kibuka-Sebitosi, 2015). In support of the articulation of modern learning interactions with processes founded in African heritage, Madzima (2010) explores how young learners have drawn on the African philosophy of *Hunhu-Ubuntu* to become successful learners in a context of modern schooling. Goduka and Chilisa (2016) elaborate on *eZiko* (the hearth) as a collaborative space of situated intergenerational learning and social innovation.

Restoring intergenerational histories and life experiences in learning

The above review of some of the challenging complexities of the struggle for relevant learning in schooling, and in the expanding contexts of youth learning in Africa, point to the need for the restoration of learning processes that articulate with life experiences, intergenerational knowledge practices and the ethical dimensions of care for the environment and each other. As we are confronted with circulating generalisations on increasingly pressing risk to future sustainability, we tend to teach the circulating environment and sustainability knowledge as necessary propositions for ethics-led learning to change. In taking this approach, knowledge commonly presents as pressing information coming in from the outside.

In the opening quote to this paper, we note that for learning the 'substance of the knowledge' that we possess, and our 'basic image of the world' are functionally independent to constitute knowledge that we can take into, and act with, in the world. This supposition points to the need for ESD curriculum processes and pedagogy where:

- The African context matters;
- Intergenerational knowledge practices shape dialectic learning;
- Life experience (ontology) animates meaning;
- Ethical purpose is emergent from these; and
- The constituting of knowledge (epistemology) comes to have relevance and purpose because it resonates with situated matters of concern and articulates with the realities of the world in which we live together.

Seen as a whole in, and out of, African socio-cultural histories, the above synthesis points to the need for not simply working from, and bringing in, new environmental knowledge in curriculum and community contexts (from the outside as it were), but to mobilise and articulate this knowledge within intergenerational learning journeys that arise in socio-cultural contexts. This premise is not easily realised with topics like biodiversity loss and climate change unless these are better situated in what makes Africa climatically challenging in relevant ways, with unique histories of knowledge practices that have sustained its peoples over many generations of living in, and creating, habitable landscapes.

Confronting the need for working from intergenerational histories in ESD

The Habitable Planet initiative of the CSIR–ACCESS[5] programme has been developed as an initiative to enhance the situated learning experiences of students in the earth sciences. The curriculum employs innovative pedagogical approaches to resolve the problem of abstraction that is dissociated from African experience. From the outset, African examples and metaphor are used to illustrate how scientific knowledge and the ethical issues relate to life experiences and cultural perspectives. This reversal casts the learner as expert on ethical issues and the learning challenge is for participants to work together to develop an 'African perspective on climate change'. However, to do so, they must first rigorously engage with the often-abstract propositions of scientific knowledge in ways that articulate with the African context. This includes up-to-date earth-sciences data on the drivers of climate change and the processes that make the planet habitable for all living things. Here the climate change curriculum has been strengthened in two significant ways:

- Animating models of process that build up an explanatory perspective on climate and the changing seasonal cycles and the locating of these in southern Africa at the intersection of the Southern Ocean, the eastern Indian Ocean and the seasonal migration of the central African Intertropical Convergence Zone (ITCZ); and
- Articulating the abstract models and unique context with African social-ecological histories and intergenerational knowledge practices.

Earlier work towards an African perspective has produced a cohort of peer educators who now deliver all of the teaching on the above concepts. In this way, the globally situated knowledge is introduced through an 'African' filter of illustrative knowledge and authentic African experience.

Next, the students are challenged to change their understanding of the nature of science itself, so they see it not as a list of abstract facts to be memorised, and a list to which western scientists are the gatekeepers, but as a continual interplay between local observations and explanatory theory.

A central tenet in this work is 'what makes southern Africa special?' Here the earth systems scientific knowledge is constituted in relation to the seasonal cycles and cultural histories of the southern African geophysical landscape. In this way, the intergenerational histories and life experiences of learners allow them to build knowledge on the regional systems and processes driving climate variability. The revelation that southern Africa is globally exceptional at something (in this case the cultural/environmental landscapes) has important symbolic value. This dispels the idea that that which is external to African is superior and it builds critical confidence, the lack of which has been identify as a key barrier to African students succeeding in higher education (Toughmay, 2014).

Turning to cultural histories, a good example here is the precolonial seasonal migrations and cultural capital for the historical mitigation of the effects of high climate variability (O'Donoghue, Shava & Zazu, 2013). Not only did the Xhosa migrate their cattle in relation to seasonal rainfall variations that we now primarily attribute to the el Nino–la Nina oscillations in the southern Pacific but they had seasonal practices (*galesha)* to optimise water retention in the soil in readiness for a late start to the summer rains in drought years.

Through the introduction of situated learning programmes blending intergenerational African knowledge with the abstract propositions of earth systems science, the Habitable Planet Programme and Fundisa for Change are effectively changing the game as learners use what they know and can relate with as special, to find out and explain changes in the seasonal cycles, and to contemplate what is to be done for future sustainability. This enables them to back reference the knowledge into people of, and in, Africa living with seasonal variability in southern Africa as a unique and special environment. This can also locate the diversity of peoples living and working in Africa in meaningful ways that are enabling us to work together in addressing the challenges of increased climate variability and seasonal change that confronts us in southern Africa today.

Endnotes

1. In this paper, 'non-sense' is used in the literal sense of lacking coherence, not making sense in that we are not able to access relevant knowledge that articulates with sustainable ways of being and doing things in the world.
2. Socio-cultural and historical perspectives that arise within life experience and have situated relevance.
3. Here 'onto' refers to lived experience, 'ethico' to valued purpose and 'epistemic' to meaning-making that is constitutive of the knowledge to provide orientation in the social-ecological environments of the world we share.
4. The Hlubi, for example, gently brush washed grain with a grindstone to crack the outer casing so that water gets in to activate the germination of fermenting enzymes that reduce phytates and release nutrients for easy digestion.

5.   This programme is part of the South African Global Change Grand Challenge initiative that is located within the Centre for Scientific and Industrial Research (CSIR).

About the contributors and their contributions

Lead author
O'Donoghue, Rob
Environmental Learning Research Centre (ELRC), Rhodes University, South Africa
odonoghue@ru.ac.za
Rob O'Donoghue is an Emeritus Professor at the ELRC. In his research on environmental education processes of learning-led change, he has given close attention to indigenous knowledge practices, social theory and environmental learning in post-colonial curriculum and community contexts

Co-author
Kibuka-Sebitosi, Esther
Institute for African Renaissance Studies (IARS), University of South Africa (UNISA)
sebitek@unisa.ac.za
Based at the IARS, UNISA, Prof. Esther Kibuka-Sebitosi conducts multi-/inter-/trans-disciplinary research underpinned by the African Renaissance paradigm. She is the current National Coordinator for the Education for Sustainable development (ESD) Expert.Net Project, a joint initiative between South Africa, Germany, Mexico and India.

Co-author
Tshiningayamwe, Sirkka
International University of Management, Namibia
sirkka.ts@gmail.com
Sirkka Tshiningayamwe is a lecturer at the International University of Management, Namibia. Sirkka is also a research associate at the Environmental, Learning and Research Centre, Rhodes University. Her research interests are in teacher education.

Co-author
Palmer, Carl
Council for Scientific and Industrial Research (CSIR)
cpalmer@access.ac.za
Dr Carl Palmer is the Education and Training Portfolio Manager in the ACCESS department of the CSIR. Dr Palmer is widely published in the field of atmospheric chemistry and Earth systems science.

Percentage contribution

Areas of contribution	Authors	Percentage contribution
Conception or design of the paper, theory or key argument	O'Donoghue	*50%*
	Kibuka-Sebitosi	*16%*
	Tshiningayamwe	*16%*
	Palmer	*16%*
Data collection	O'Donoghue	*50%*
	Kibuka-Sebitosi	*16%*
	Tshiningayamwe	*16%*
	Palmer	*16%*
Analysis and interpretation	O'Donoghue	*50%*
	Kibuka-Sebitosi	*16%*
	Tshiningayamwe	*16%*
	Palmer	*16%*
Drafting the paper	O'Donoghue	*50%*
	Kibuka-Sebitosi	*16%*
	Tshiningayamwe	*16%*
	Palmer	*16%*
Critical review of paper	O'Donoghue	*50%*
	Kibuka-Sebitosi	*16%*
	Tshiningayamwe	*16%*
	Palmer	*16%*

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Territory and ontology in the educational practices of an indigenous Zapotecan community in Mexico

Raquel Aparicio Cid, Universidad Veracruzana, Mexico

Abstract

This paper is inscribed within the study of social educational practices in rural indigenous communities of Mesoamerica, practices through which the store of knowledge that guides relationships with the environment are recreated. Ethnographical research conducted in a Zapotec community in the state of Oaxaca, southern Mexico, shows that communitarian educational practices form an everyday cognitive–axiological framework through which the norms of coexistence and social organisation are assimilated. The underlying purpose of these practices is to promote the historical and cultural continuity of the collective based on a reciprocal relationship with the environment, which is their home and the source of their well-being and biocultural identity. The resilience of this population lies in their use of socio-historical learning to renew their organisational structures, with the purpose of facing the challenges posed by civilisation. This paper describes aspects of these historical learnings and current social educational practices, as well as their ontological principles.

Keywords: indigenous communities, communitarian education, communality, nature.

Resumen

El artículo se inscribe en el estudio de las prácticas formativas comunitarias en poblaciones rurales indígenas de Mesoamérica, a través de las cuales se recrean los acervos de conocimientos que orientan las relaciones de esos grupos con sus territorios. Una investigación etnográfica realizada en una comunidad zapoteca del estado de Oaxaca, al sur de México, muestra que la educación comunitaria conforma un entramado cognitivo-axiológico cotidiano a través del cual se asimilan las normas de convivencia y de organización social. La intención ulterior de esta formación es propiciar la continuidad histórica y cultural del colectivo a partir de una relación recíproca con el territorio, que es su hogar, fuente de bienestar y de su identidad biocultural. La capacidad de adaptación de esta población se explica en el aprovechamiento de los aprendizajes sociohistóricos para renovar sus estructuras organizativas, con el fin de enfrentar los retos que le plantea el devenir civilizatorio. En este texto se describen algunos aspectos de esos aprendizajes históricos y de las prácticas educativas sociales, así como de sus principios ontológicos.

Palabras clave: comunidades indígenas, educación comunitaria, comunalidad, naturaleza.

Introduction

In the midst of the prevailing civilisational crisis, the epistemic practices of traditional societies are attracting growing interest from the social and natural sciences because of these societies' capacity for generating knowledge that 1) responds to unprecedented situations in their social lives and in their relationship with the environment, and 2) enables them to develop a significant level of adaptability to internal and external changes.

Indigenous, local, or traditional knowledge systems are inscribed in what Rengifo (2015) calls 'other knowledge': that is, knowledge systems based on cognitive and cultural premises that correspond to a type of knowledge and epistemic–ontological perspectives that are different to modern thinking. It refers to knowledge that has been constructed, preserved and used by communities and traditional people such as the indigenous groups of Latin America, knowledge which shapes the heart of these cultures and 'has an enormous potential for the understanding and solving of different social and environmental problems' (Olivé, 2009:21). In the specific case of Mexican indigenous peoples' knowledge systems, Boege (2008) and Toledo and Barrera-Bassols (2008) consider such systems as a reference for the creation of new models of society better able to deal with the current civilisational crisis.

This knowledge is intrinsically bound to practices centred around administering local ecosystems to meet livelihood needs (Toledo & Barrera-Bassols, 2008) and is the result of lengthy interactions between communities and their environment. It arises from individual and social experiences developed in a context of continuous change (Barrera-Bassols, 2003), which, when imprinted in concrete processes of social interaction, develops its own pedagogies (Chamoux, 1992; Gómez, 2003; Nahmad, 1988) through which knowledge is inherited in a trans-generational way (Toledo & Barrera-Bassols, 2008). This suggests that communitarian educational practices are critical for understanding the ontological foundations of the relationships traditional societies have with their environment, as it is through these practices that the meaning of nature and the environment is developed in congruence with the culture and the collective project of life.

From this argument arises the relevance of cultural diversity for the planet's future. Assuming 1) that culture is the mechanism through which human beings interact with their environment (Ángel-Maya, 2003); 2) that the global socio-environmental crisis is a consequence of a mono-cultural society (Quijano, 2000) and of a predator lifestyle pushed by western civilisation (Mignolo, 2014); and 3) that cultural and epistemic diversity emerge as indispensable for facing the problems of civilisation, it is then possible to say that human survival may ultimately rely on cultural diversity (Milton, 1997; Toledo, Alarcón-Chaires, Moguel, Olivo, Cabrera, Leyequien & Rodríguez-Aldabe, 2002).[1]

This paper presents the results of research focused on the study of certain communitarian educational practices that retain the historical–cultural continuity of an indigenous population's relationship with their natural environment within a scenario of the changes propagated by diverse mechanisms of the world-system (Quijano, 2000).[2]

One of the objectives of this study is to identify the epistemic elements and ontological principles of said practices, with the aim of enriching the theoretical–practical framework

of environmental education for sustainability.[3] For such a purpose, the selected community presents a relevant profile because its members acknowledge a process of productive transition as a necessary life-changing project and, despite this, their educational social schemes continue to reproduce the values and elements of an ancestral culture, one that is closely connected to its relationship with the environment and to the principle of communality in all its collective relations.[4] This study was rooted in the assumption that, even in changing processes and similar social challenges, this type of social education can constitute a tool for the transformation of those civilisational paradigms that are placing global ecosystems at risk.

La Trinidad Ixtlán is located in the region known as the Sierra Norte in the municipality of Xiacui, Oaxaca, southern Mexico. This agrarian nucleus encompasses 805 hectares of temperate forest, 704 of which are under communal land ownership and forest management. Commercial forest management represents an important source of income and social benefit for the population.

The community, with 783 inhabitants, is governed by an indigenous normative system which informs their administrative–political organisation. The supreme governing body in this system is the General Assembly of *Comuneros* (community land co-proprietors), which is responsible for discussing problems and making decisions on issues related to social organisation and to managing the environment.

Methodological approach

This qualitative research was undertaken as an ethnographic profile through an immersion in the community. Data gathering was carried out via the active observation of, and interviews conducted with, diverse community actors. Observation was centred progressively on three aspects: the actors' daily activities; the verbal expressions generated during the activities; and the communicative interactions that the researcher held with several interlocutors. Since 'verbal action is, merely, another form of social action' (Díaz de Rada, 2011:50), the material obtained was considered ethnographic, as it involved extended processes of communication and cultural reproduction. Taking the records of the field journal as a base, and as a result of an ethnographic analytical procedure, observation tables were developed to record specific communitarian educational practices.

In addition to holding informal conversations with several community actors, 14 interviews were conducted with people whose activities are directly related to the land, mainly in agriculture and forestry. Three of the interviewees were women and eight were men, with ages ranging from 40 to 82 years. These interviews were structured so as to identify, from the interviewers' perspective, the community's most significant historical events that come into play in their current social behaviour and collective understanding of their environment. In turn, the main analytical categories emanating from the observations were consolidated with a content analysis of the interviews. The set of results arising from both procedures form the basis of the theoretic–epistemic reflection that made it possible to infer 1) the components of the communitarian educational practices and 2) the historical and personal learnings influencing the social construction of contemporary notions regarding community life and the natural environment. This work is detailed below.

Identification of communitarian educational practices

The communitarian pedagogical practices were studied in family life and in productive work scenarios, as well as in the context of communitarian daily life where these were made evident. Some of the interactions that show the effects of social education are: the observance of public order; actions and discussions on social organisation – particularly issues related to the General Assembly of *Comuneros*; forest enterprises; the performance of the authorities; and conversations on social, political, historical, cultural, productive and environmental events.

Ornelas (2007) points out that, from a broader perspective, educational practice is omnipresent in all kinds of human interaction, it overcomes intentionality and systematicity, and addresses not only the present or daily life but also socio-cultural and historical processes. This idea guides the view of social phenomenon as a permanent educational process whose learnings are cumulative and, at the same time, continuously recreated. This poses a methodological challenge: if the educational practice 'implies teaching–learning processes are intrinsic to the different ambits of personal interaction' (Ornelas, 2007:89) and if, in a context like the one studied, almost every social practice can shape an educational practice, how is it possible to define what exactly is educational in community interactions?

A conceptual formulation of the social educational practices was first determined through conversations held with certain *comuneros*, then complemented with relevant theoretical sources that enabled the setting of a basic model for recording and analysing the social educative schemes described. The information from the empirical and theoretical sources was systemised and summarised in a table template that enabled the organisation of the data obtained from interviews as well as the recording of the observations on certain social organisational practices and the factors shaping them from an educational perspective. Such factors are: the object of knowledge or content; the methods, processes or techniques for teaching–learning; the environment as a learning or educative space; the temporal context (either the actual moment of the educational practice or the historical moment, or both); the tools, instruments and resources, either material or symbolic; the practice's level of institutionalisation; and an evaluation of the learnings.

As a result of this systematisation and analysis, the characteristics of the four central schemes within the social educative group were identified: the historical learning related to the environment; external technical capacities; educative community practices for cultural and communitarian continuity; and the family educative schemes for the subsistence and biological reproduction of the group.

This conceptual formulation was presented to three senior citizens in the community for the purpose of discussing the formulation's relevance and validity. This feedback led to the finding that external training is currently no longer relevant since it has fulfilled the purpose for which it was required, and so it was decided to integrate it as part of the socio-historical learnings. It was also found that the educative family schemes for subsistence do not represent a widespread educational social practice as a result of the gradual abandonment of these primary activities at home. Nevertheless, within family education practices, families do not in fact ignore the enforcement of community values related to their environment and community life; what

prevents the functioning of this axiological construction is the individual's physical detachment from the land. Conversely, in the case of farmers and forestry workers, the relationship with the land is close and constant, fostered as it is by work.

In this manner, and in contrast with several indigenous and farmer communities in the country where the family structure for subsistence is paramount, the social educational schemes for cultural and community continuation in La Trinidad Ixtlán remain very influential thanks to their absorption–reproduction through community organisation, collective practices, shared values and individuals' behaviour. Such schemes have incorporated socio-historical learnings and have as their goal cultural, social and biological continuation, which emanates from the basis of their lives, namely their communal territory.

The following sections describe the historical learnings related to the environment and a specific communitarian educative scheme based on those lessons. They describe the way learnings were incorporated into the store of communitarian knowledge and how they define the current community–territory relationship.

Socio–historical learnings: The strength of the community

During the 20th century, La Trinidad Ixtlán was affected by several historical events, two of them of particular significance: the legal dispute on territorial boundaries between neighbouring villages in the 1940s and, in the 1950s, the imposition of government concessions that barred them from administering their forests for a long period.[5] In both cases, and because of their vast historical and cultural richness and their significance for the well-being of the community, the population deployed several strategies to recover the ownership and management of their lands. These events generated critical conditions for action and created a favourable situation for the deployment of several cognitive and cultural factors as well as for the generation of new learnings related to the management of their territory.[6]

Concerning the forest concessions, the community actively sought specialised technical and legal advice to deal with the problem, enlisting assistance from a group of engineers and professionals, who trained several dozen *comuneros*. This relationship led to knowledge transfer and to the development of skills on exogenous topics, which were all swiftly adopted. In addition to this knowledge, the process represented a profound social learning that to this day affects productive practices and the people's view of their environment within their perception of time.[7]

As in the past (and this constitutes the recursivity of the processes of social knowledge production), such learnings – reproduced by the people who have lived through those events, today most of them senior people – have a direct moral incidence in collective behaviour towards the environment (conservation and sustainable management) and are based on the community's awareness of their dependence on the environment for their welfare. A carpenter from the community says the following:

> We depend a lot on the forest and that is why we have the idea that we must take care of it. Right now we are the ones benefiting from what our ancestors accomplished. And we are doing

> the same thing, managing our forest, not exploiting it, and from there we are planting more so the ones coming, the generations after us will also have a forest.

Practically all the people with whom there was interaction explained the importance of the interdependence between the community and the natural environment for their mutual well-being. Through this awareness, the need to renew collective knowledge is recognised. An employee of the communitarian forest company affirms that the village stands out because of its capacity for analysing and solving problems:

> The community has always been distinguished because both *comuneros* and citizens learned from the elders, they were very protective of what we had. And the village is here thanks to that intention, that thinking of the elders, so the village would never falter, so that we could thrive.

From an educational code's perspective, history is an essential formative agent for these learnings, as are the historical actors – in other words, the ancestors who participated in decision-making processes and actions in defence of the territory. Traditionally, elders are important educational agents in the familial and social spheres.

As learners, we can identify the actors who lived or witnessed said events, their contemporaries, and their descendants, as well as the subsequent generations that have recognised the effects of these actions and motivations. A *comunero* says:

> Despite its problems and setbacks, the village is like a home, it has had its ups and downs but it is still going. From everything we have lived through, we have learned and we have never stagnated in just one circle.

Some of the most relevant lessons are oriented towards endorsing the continuity of communitarian life and its values, as well as towards fostering an awareness of the fact that living generations are affected by the decisions and actions of their predecessors, and, accordingly, current actors should also be responsible for taking care of the natural heritage for those to follow.

In addition to the everyday practice of communality, some pedagogical resources include the social capacity for sharing opinions, debating and reaching agreement, for it is through these processes that learnings are shared, and meta-learnings can emerge when a meditative historical perspective is added. A vital pedagogical resource, as mentioned above, was the situation of crisis that triggered the plan of active resistance and the gathering of the necessary knowledge to do so. Necessity, interest, will, time and disposition are also added to the collection of social resources that enable these procedures.

These learnings are institutionalised and internalised in the current society. They are transformed into knowledge that is shared through social and familial pedagogies with new generations. In this way, they are established in the present life of the community and reproduced through community education.

Figure 1. Commercial forestry activities in La Trinidad Ixtlán, Oaxaca. Photo: Jiangsu Olea.

Community education and social values

As well as common ownership of the land, social organisation is vital for the historical continuity of La Trinidad Ixtlán. For such purposes, communitarian education constitutes an indispensable tool because it transmits the very knowledge and shared values that make historical continuity possible. Community life is in itself a permanent educative process in several areas, particularly in that of community service, one of the central axes of social organisation governed by the indigenous normative system.

The axis of the indigenous normative system is called the *sistema de cargos* (a system of key roles and duties), in which male citizens over 18 years of age are required to perform many communal and administrative roles (around 30), all without remuneration.

Most of the interviewees refer to their experience in the *sistema de cargos* as a school for the subjective learnings related to the life of the community, while others perceive the experience as one that creates good citizens. In other words, there is a conscious intention, or at least a precise sense of purpose, in the way in which community service prepares people for community life and the maintenance of collective good. An 82-year-old farmer says:

> The community is wise. Most have already passed through all appointments, they know. There are rules: everyone in the community knows them.

It is observed in this educational practice that the subject who learns is, in the first instance, the young citizen who joins the service, but also that same citizen further along the ladder of communitarian service, whereby, in a broader sense, this learner 'graduates' when he is 60 years old.

Because of the socialisation effects of this practice in the heart of the home, family units can be viewed as indirect apprentices. In other words, every situation or event related to the collective is shared with the whole community, either through formal channels or by the daily flow of communication into and among family groups. Intra-communitarian communication plays a relevant role in this circuit, where the community is itself an educative agent.

One of the main purposes of this educational practice is that the *comunero* experiences all positions of command (that is, community service), which imposes different perspectives on the subject, enriching his individual education and his journey as a citizen by providing him with learnings on community life. Through the experience of this service, the historical knowledge that shapes the current profile of the community is reaffirmed and critical thinking and decision-making capacities are generated. The *comuneros* learn to discern the importance of natural and social environmental knowledge and of transmitting these cultural values to the nuclear family, who, in turn, will incorporate them into their behaviour. Said values are condensed in the idea of communality: the solidarity, reciprocity, mutual care, service, respect, sharing, obedience and responsibility necessary for growing and living together.

The pedagogical strategies in this educative approach lie in the performance of the community, as the main teachers, in the act of serving: in the knowledge and responsibilities that correspond to a specific role in the *sistema de cargos*, and in the constant practice of reflection on, and analysis of, social events.

Here, even mistakes are seen as a form of learning. A *comunero* explains the role of mistakes in people's education:

> The lesson that the elders gave us is that, if you make a mistake, you must not dwell on it, but improve yourself and make it better. I mean to focus on learning from our mistakes, be the best you can. Because those elders, if they made a mistake, they learned from it, and they did good things that taught us.

Other strategies include awareness raising, problematisation and the collective search for solutions, as well as the exchange of experiences and points of view with other community actors and external agents.

The location of this practice is community life. The temporal context exits in 1) the biographies of the individuals throughout their participation in the chain of communitarian appointments in the *sistema*; 2) the history of the community, through the training of its members in communitarian service and governing; and 3) in daily social or work interactions. This educational practice comprises wide spaces in the lives of community members, and frequently extends beyond the community as a result of the multiple actors interacting with La Trinidad because of its status as a model forest community.

Conclusions: Ontology as the basis for communitarian education

The educational practices here described reveal the ontological principles that underlie the collective disposition of La Trinidad Ixtlán in maintaining a relationship of reciprocity with their natural environment and in maintaining a way of life that favours the common good.

From the present study, it can be concluded that one of the principles of such a disposition is the recognition of the community's direct dependence on the environment for biological subsistence, which in turn allows the social and cultural reproduction of the social fabric. Martínez (2015) affirms that when a society understands itself as part of nature, this appreciation enables life's reproduction and the creation of necessary knowledge, and strengthens the possibilities for the society's continuation.

A second principle is expressed in a subjective and inter-subjective awareness of belonging to the environment, as part of nature, which is then incorporated into notions of personal and cultural identity. This awareness is apparent in the community's bio-cultural identity.

The third principle is linked to the perception of time and involves taking care of 'the other' for mutual benefit, with the other including both humans and non-humans. This principle encompasses the continuity of life in all its expression, and is therefore of an evolutionary character.

This set of principles comprises the foundational purpose of this population, which is the possibility of existence, an ontological motivation fused with the environment. These principles are assimilated in the subject, the culture and in the community's store of collective knowledge, which is reproduced in every generation through the previously described educational practices. As a one of the *comuneros* says: 'From everything we have lived, we have learned'.

La Trinidad Ixtlán is an example of other possible ways that humans can relate to natural resources through ontological principles – principles that have materialised thanks to solid social organisation, a strict governance of the environment, and a great adaptability towards change. In the context of the aforementioned social practices, the community's capacity to recreate its learning strategies and store of knowledge (in order to successfully deal with the internal and external challenges posed by the historical, civilisational and environmental future) is very distinct. Following from this description, it is possible to view this population as an adaptive society (Ángel-Maya, 2003).

Although this study refers to a specific case, these approaches strengthen the argument that cultural and epistemic diversity offer an alternative to the current civilisational crisis that threatens, on a global scale, the conditions of life. Further, the research findings also highlight the importance of social educational processes in the development of sustainable societies.

Endnotes

1. A holistic perspective evokes the concept of biocultural diversity. According to the National Commission for the Knowledge and Use of Biodiversity (Conabio, 2018), the biocultural axiom views biological and cultural diversity as mutually dependent and geographically tied. The biocultural relationship is thus a consequence of the interdependence between human societies and their biological surroundings.
2. Boege (2017) names as neo-indigenous those types of communities of indigenous heritage who have included elements of modern civilisation into their cultural tradition.
3. See Aparicio (2017).
4. Communality is defined by Martínez (2015) as an experiential concept that allows for the comprehensive, total, natural and communal understanding of life. Such a concept is based on four inseparable aspects: nature or the environment, the society or community that inhabit such a place, the work that is done by such a society, and what it receives for belonging to the social group and to the environment. This concept emerged as a social category in the region of the Sierra Norte of Oaxaca as part of the reflections developed during the fight against the forest concessions of the 1980s.
5. In the first case, once finalised, the ownership dispute with the municipal capital, Xiacuí, La Trinidad Ixtlán received a Presidential Resolution on the ownership of their lands in 1948. In the second case, the federal government gave the concession to a paper company to exploit, for 25 years, more than 260 000 hectares of temperate forests in the region where La Trinidad is located (Winder, 1992). The concession expired in 1981, with plans for its renewal; however, the villages were able to prevent that.
6. Boege (2017) claims that reflections concerning the environment are triggered by a threat, causing a social movement that is usually reactive. He claims that crises permit the mobilisation of certain physical and symbolic elements of the communities, which are constantly reinventing themselves.
7. The concept of time in this community differs to the one of modern civilisation. Their perspective is not lineal or ephemeral, nor successive, but the past, present and future are rather perceived to operate simultaneously. This view is the legacy of the pre-Hispanic Mesoamerican cultures prevailing in their descendant populations: The Sacred Time (Boege, 2017). According to Eliade (1959), Sacred Time makes possible regular time, which is the ordinary passage of time in which all human existence goes by.

Notes on the contributor

Aparicio Cid, Raquel | Universidad Veracruzana, Mexico |
ORCID 0000-0003-0711-1769 | aparicio.cid@gmail.com
Raquel Aparicio Cid has a Phd in Educational Research and a Master's in Environmental Education. Her research interests are focused on environmental education, social educational practices, traditional knowledge systems, and human–environmental relations.

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The legend of *Achaneh*: Socio-ecological knowledge in the oral tradition of fisherwomen in Veracruz, Mexico

Juan Carlos A. Sandoval-Rivera, Universidad Veracruzana, Mexico

Abstract

Based on ethnographic fieldwork conducted in an indigenous community of Veracruz, Mexico, traditional socio-ecological knowledge was identified embedded in the oral tradition of fisherwomen of the local community. The reflections presented show the educational potential of indigenous knowledge that, from their own epistemology, has allowed the inhabitants of this community to regulate the way in which they relate to each other and to their environment in a sustainable way over the centuries. The findings presented in this article bear testimony to the socio-environmental relevance of these local indigenous narratives as situated philosophies which are important to document so as to move towards a scenario of sustainability arising from a dialogue between the local and the global.

Keywords: oral tradition; socio-ecological knowledge; indigenous knowledge; education for sustainability.

Resumen

Durante un trabajo de campo etnográfico realizado en una comunidad indígena de México, se identificó en la historia oral de pescadoras de la comunidad, la presencia de conocimientos socio-ecológicos afines al paradigma de la sustentabilidad. A partir de las historias recopiladas durante la investigación realizada, se muestra el potencial educativo del conocimiento indígena que, desde su propia epistemología, ha permitido a los habitantes de esta comunidad regular la forma en la que se han relacionado entre sí y con su entorno a lo largo de los siglos. Los hallazgos presentados en este artículo dan testimonio de la relevancia socio-ambiental de estas narrativas indígenas locales que se retoman como filosofías situadas, las cuales pueden ser importantes en el tránsito hacia la sustentabilidad a partir del diálogo entre lo local y lo global.

Palabras clave: tradición oral; conocimiento socio-ecológico; conocimiento indígena; educación para la sustentabilidad.

Introduction

In this article, I will present some reflections concerning indigenous socio–ecological knowledge contained in the oral tradition of Nahua fisherwomen (see Figure 1) in the Zaragoza community in southern Veracruz state, Mexico. These stories were recorded in interviews, informal conversations and audiovisual recordings of the fisherwomen's accounts, as well as participant observation of the various fishing tasks carried out by the women. This was all recorded in this indigenous community during the fieldwork conducted for my doctoral research.

The legend of *Achaneh* is part of the oral tradition in Zaragoza that, for centuries, has been passed on from generation to generation, mainly among the people who participate in traditional fishing practices. In the story, *Achaneh* is a woman who owns all the bodies of water in the community. She takes care of the water and is therefore also the owner of all the creatures that live in the water. If anyone wanted a good catch, they would have to make an offering to her or remain respectful, both towards people and towards the environment, otherwise their fishing would not go well. Some people from the community who have already passed away, swore that they had seen her. 'The Legend of *Achaneh*', as it is known in the community, has been embellished and rearranged through many accounts which, across the centuries, have been passed down in order to teach ethical principles relating to coexistence and a respectful use of natural resources.

Figure 1. Fisherwoman

Source: Author

What is indigenous socio-ecological knowledge, and why is it relevant to the field of education?

Knowledge that has been constructed by indigenous peoples (indigenous ways of knowing and doing) has been given several names: 'indigenous knowledge', 'endogenous knowledge', and 'traditional ecological knowledge', among others (Shava, 2013). Before arguing for its relevance, I will define what I mean by the term 'indigenous knowledge'. I will take up the definition of Grenier (1998:1–2), who refers to knowledge that is:

> […] unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area […]. Indigenous knowledge is stored in people's memories and activities and is expressed in stories, songs, folklore, proverbs, dances, myths, cultural values, beliefs, rituals, community laws, local language and taxonomy, agricultural practices, equipment, materials, plant species, and animal breeds. Indigenous knowledge is shared and communicated orally, by specific example, and through culture.

One characteristic of indigenous knowledge is that it is related to every aspect of life, including, of course, the ecosystems on which communities' survival has depended. Since these systems of knowledge are cumulative, they represent generations of experience and careful observation, and are the result of experiments developed over thousands of years. It is knowledge that is encrusted in the very culture and embodied in its practices (Shava & O'Donoghue, 2014). Therefore, it is knowledge that is generated in a specific local context in response to specific local problems (George, 1999).

Maurial (1999:63) notes that indigenous knowledge is 'the result of the quotidian interactions in indigenous peoples' territories. These interactions occur among families, communities and indigenous peoples. Indigenous knowledge is immersed in the whole culture and is recreated through successive generations. The essence of indigenous knowledge is that it is alive in indigenous peoples' culture. Different from western knowledge, it is neither in archives, nor in laboratories. It is not separated from everyday peoples' lives. In educational terms, Kincheloe and Steinberg (2008) consider approaching indigenous knowledge as necessary to counteract the destruction of our planet that the daily workings of western science lead us to cause.

From the academic and scholastic fields, a recognition of the value of indigenous knowledge allows us to analyse reality and its challenges from a range of perspectives that can help to focus and channel our efforts toward solve the problems now facing humanity. The more perspectives we can consider, the closer we get to understanding reality (Reynar, 1999). In this way, different frames of reference create multiple interpretations and multiple realities. A multi-logical and diverse epistemology and ontology support a detachment from reality that allows us to observe reality from the points of view of diverse ontological (Stetsenko, 2008) and epistemological (Santos, 2006) frameworks. Hence, in relations between actors coming from different epistemological frameworks, there may be complex matrices of interaction, codes and meanings that can create a dialogue to encourage understanding. In order to promote dialogue

between different kinds of knowledge (indigenous and non-indigenous), the biggest challenge is to perpetuate the *cultural systems* that produce the indigenous knowledge (Kincheloe & Steinberg, 2008) more than the *knowledge* itself.

Similarly, concepts derived from the perspectives of those who have historically been excluded allow us to visualise the power of difference, the processes of oppression and the limitations of monocultural ways of building meaning (Reynar, 1999). Kincheloe and Steinberg (2008) note that the multi-logical understanding of a particular reality is a new kind of logic, unrecognised by the 'sleepwalking' dominant culture. Therefore, the political stance behind this position can be considered as alerting us to the form in which we normally give meaning to reality: the academic–scientific perspective. It is worth noting that, being contextualised in its production and use, indigenous knowledge is difficult to reproduce or universalise, since the contexts in which it is produced change according to where it can be reproduced, especially if we seek to use it in contexts of conventional scientific research or in the framework of official education.

Education, indigenous knowledge and the Sustainable Development Goals

The Sustainable Development Goals (SDGs)[1] (UNESCO, 2015) are presented as a complex collection of desirable elements in the drive for sustainability, in which education clearly has a relevant role to play. It is not necessary to point out the contemporary problems that modernity and our present economic model have caused for our planet in order to recognise that this international agenda is pertinent to shaping our future by carrying out urgent actions in the present. Nevertheless, the discourses presented by this agenda show us a series of socio-ecological problems and challenges through 17 goals that are not easy to decode and work on at a local level, above all due to the variety of ways in which what is stated may actually be understood. In the same way, the concept of sustainability can also be difficult to understand due to its symbolic and sometimes rhetorical connotations (González-Gaudiano, 2001) associated with the SDG concept since it first appeared. Thus, in indigenous contexts, it is relevant to talk about complexity in visualising and orchestrating the transition towards sustainability using the SDGs as a guiding tool, when we start, for example, with the fact that, in Mexico, there are around 364 varieties of indigenous languages (INALI, 2008).

Following on from this, during an exploratory study in indigenous communities in Mexico in 2015 and 2016, it was observed that the implementation of the SDGs has not been easy, when issues of social and ecological justice are not dependant on local factors, but rather on external ones, or where the concerns of indigenous peoples have not been carefully considered in an inclusive way. Faced with such complexity, the need arises to recover knowledge practices still present in indigenous regions (Bishop, 1995) that permit an exploration of how, in the transition towards sustainability, social and ecological well-being are visualised in indigenous world views (Boff, 2013), and how they can be coordinated with the dispositions and expectations for indigenous peoples contemplated in the SDGs.

Implementing education directed towards socio-ecological transformation is not an easy matter. Nevertheless, if we recognise that there are still philosophical (ethical–political) perspectives that, on the margins of modern society, have been able to produce and maintain

healthy socio-ecological systems (such as indigenous philosophies reflected in oral folktales), we can include them in educational schema directed towards sustainability and find out how local and international perspectives and agendas can complement each other.

Indigenous knowledge and sustainability

In the worldviews and practices of indigenous peoples, we find the clearest examples of civilising proposals that focus their attention on balance and life; and which therefore constitute the sustainability we seek (Boff, 2013). However, in a global and modern context full of injustice and contradictions, a community (indigenous or not) can be considered sustainable when it takes (or recovers) control of the processes that determine or affect it (Toledo, 1996). In this way, if a community has ceased to be sustainable for whatever reason, the first action that the whole community should carry out to regain socio-ecological balance is to take control of their territory; that is, to manage their ecosystems in an adequate, non-destructive way, which is achieved by means of the knowledge available to take the necessary decisions. In a globalised world, this knowledge could come from several sources: from technical staff in development agencies or non-governmental organisations (technical knowledge); from the academic field (scientific knowledge); or, as shown in this article, from the knowledge created and transmitted from generation to generation (indigenous knowledge).

Therefore, faced with the complexity of the socio-ecological challenges before us in the present day world, we need to recognise epistemological pluralism from this range of sources of knowledge (Olivé, 2009) in order to lay the foundations for an inter-epistemic dialogue in which indigenous philosophies cease to be subjugated knowledge and instead take on a leading role in the decisions that affect all societies.

The indigenous peoples of the world have, over time, maintained a close relationship with the ecosystems with which they have coexisted; their very contact with nature has allowed them to create knowledge and practices connected to nature in order to survive. Similarly, their ecosystems have determined the way in which these communities have adapted to their environment, influencing the development of their knowledge and practices.

There is significant evidence showing that those parts of the world rich in *biological* diversity are also areas with high *linguistic* diversity. '[N]ine of the twelve main centres of cultural diversity (in terms of the number of languages) are also on the list of biological megadiversity and, reciprocally, nine of the countries with the greatest variety of species and numbers of unique species are also listed in the 25 countries with the highest numbers of native languages' (Toledo, 2003:67–69). This statement constitutes an emerging paradigm in which cultural diversity is connected to biodiversity, each being interdependent on the other (Sandoval-Rivera, 2015).

The legend of Achaneh, fishing and crocodiles

In this section, as evidence supporting the above claims, I will present accounts of the socio-ecological importance of the stories told by the fisherwomen concerning the management

of their environment. The stories were transcribed in their entirety with no editing, with the intention of showing the whole narrative contained in these accounts in which the relationship between fishing, crocodiles and *Achaneh* is identified. The message of the Legend of *Achaneh*, according to the fisherwomen interviewed, tries to teach values and the regulation of human behaviour for the improved coexistence of the community and its environment. Around this knowledge, as expressed in the oral folktales, interrelations between traditional fishing, the biological conservation of the species of crocodile found in the region (*Crocodylus moreletii*) and the sustainable management of ecosystems from a local viewpoint, can be identified.

In the accounts, the close relationship between the fishing sites and the places where the crocodile lives can be discerned:

> Firstly, I have been told that the crocodile is an animal that's closely related to fishing. My uncles, who've now passed away, used to tell me that where there is a crocodile that means there are fish. I don't know why, but they always used to tell me, 'Where you see a crocodile, go and fish there, because you're sure to find fish.' *(Lucía, fisherwoman)*

Similarly, they try to explain through the relationship between the crocodile and the fishing, the role the crocodile plays in the ecosystems:

> I think the crocodile is an animal that's in the water to regulate fishing. The presence of a crocodile in a place means there are fish there. And the crocodile is also there to make sure nobody takes all the fish. That's the crocodile's function. Besides, where there's a crocodile there will always be bodies of water and so there will always be places to fish. And that's why we shouldn't kill them. *(Juana, fisherwoman)*

Another account agrees with the previous one concerning the role of the crocodiles and the way in which *Achaneh* and the crocodiles are related:

> The crocodile's role is to take care of the fish, he brings the fish, the fish go with him; where there is a crocodile there are many fish, and when he goes, he takes the fish with him. My mother says that once they killed a large crocodile, it was out of the water, sunbathing, and a man found it and killed it. This man was told in a dream not to go fishing anymore, because if he did, he wouldn't be coming back home. They say that when he wanted to go fishing one time, many crocodiles appeared and chased him. That is the crocodile's role: to take care. And our grandparents say that the crocodiles are like *Achaneh*'s dogs, because they're the ones who take care of her home so that nobody damages the rivers and lakes. *(Julia, fisherwoman)*

In other accounts we can identify that the importance of the crocodile is not only ecological but also cultural. Some messages are identified relating to moral values for family life. The following account is a clear expression of the punishment of a person who does not respect the rules established by the 'owner of the water', and the account thus corresponds to the connection between *Achaneh* and the crocodiles for regulating community members' behaviour:

My grandparents used to say that it was the same crocodiles that were there in the water that would threaten people. My grandfather says that he knew a man called Pedro, and this man went fishing a lot, but he had another woman, and instead of taking food to his children he took food to the other woman who wasn't his wife, and the owner of the water didn't want him to do that. He used to get very sleepy every time he went fishing and sometimes he fell asleep while he was fishing. The first time he fell asleep while he was fishing, he says that *Achaneh* told him in a dream not to fish, that if he did, he should take the food to his children. But as the man had another woman, he couldn't take food to his own children, because he had promised to take it to the other woman. The second time he went, the same thing happened in his dream, *Achaneh* kept telling him not to fish, or if he did, he was to take the food to his children, because if he didn't, he wasn't going to make it back home. The man didn't take these messages seriously even though he received a third message while he slept; *Achaneh* told him not to go fishing anymore, because if he did, something bad would happen to him, and it's true, it happened. It happened to him because the third time was the last; when he went, they say that a great crocodile appeared and bit him. With the bite the crocodile cut off his leg; they say the man shouted in the water, calling for help, but who would hear him in the lake? They say the crocodile followed the man as he dragged himself along until he managed to get away from the lake shore, but he was severely wounded. The next day the crocodile found the man and ate him. Our grandfather told us, he said that his father saw this happen, and, well, he says that's what happened and it's true. My grandfather always told us how it happened and says that above all he guided us because the water is sacred, 'They won't do you any harm when you do what's right'; at that time the water was very sacred, but not so much now. *(Olivia, fisherwoman)*

A relationship is also established between the presence of a crocodile and very deep fishing spots, as well as a proportional relationship between the number of crocodiles that can be found in a body of water and the quantity of fish that may be caught there:

My uncle used to tell me, 'Look, when you go fishing and you see a crocodile, go in carefully because it's sure to be deep there.' Those who live from fishing say that when a crocodile passes by there are normally fish. Where there's a crocodile, there are fish, but where there are several crocodiles there are lots of fish. They say it's because the crocodiles attract them. I have my own reasoning, but all the same it might just be mine; I suppose it's a way fish have of protecting themselves from people. Because the fish know that a fisherman isn't going to get in the water where the crocodile is. Here we have the belief that the crocodile draws the fish in, that he attracts them. And it's true because, for example, there's a place called Estero Mudo *[Silent Marsh]*, there are a lot of pools there that are very deep, too deep, and people hardly go fishing there, and they say there is a really good stock of fish there, a variety of fish too, but they hardly dare fish there because it's very deep and the crocodiles are there. *(Juana, fisherwoman)*

There is a relationship between the legend of *Achaneh* and the crocodile, and also other species that live in the wetlands in the region such as a species of turtle that has as much to do with the balance of community living as it does with that of the management of ecosystems. These

relationships between species and knowledge make up part of the local worldview and of what is passed on in the oral traditions of Zaragoza:

> The legend tells us that the crocodile is not the owner of the water, the owner is really *Achaneh*, and as the owner she has the crocodiles among her animals, just as we keep pets. The crocodiles are *Achaneh*'s dogs; and the big turtles, those white ones, that there are almost none left of, and that are rarely caught, that's where *Achaneh* sits. Here we used to have, many years ago, where we used to sit, a kind of stool made of wood, and that's why people a long time ago believed that *Achaneh* took those turtle shells as seats, but of course she used to take them with the turtle still alive. And they believed that these animals [the crocodiles and the turtles] obey the voice of *Achaneh*. In that respect they consider the crocodile to be a dog and that it's in charge of taking care of the bodies of water. Because *Achaneh* doesn't come, she's not the one who directly chastises you for doing or not doing something, rather she sends her animals to give you the message. But that's only if you're going to do something bad in the water or if you're going to do something that will destroy the habitat that they are in. But if you treat them with respect and fish properly, which is just to feed your family, then there is no problem and you can go there even if there are crocodiles. *(Juana, fisherwoman)*

In the relationship between *Achaneh* and fishing, there are also mechanisms that regulate the number of fish that can be caught by a single person. This is fundamental in ecological terms and in terms of managing ecosystems, since ecosystems have a limit to what can be taken from them without their deterioration. From this perspective, this ecosystem management is found in the legend itself and in the knowledge of the fisherwomen, as the oral tradition recommended rationing fishing in the community:

> Our grandparents also used to tell us that when fishing you have to catch what you're going to need and no more, because other people need to fish too. That's the way our ancestors thought: 'Take what you're going to eat, and that's more than enough, don't look at it with greedy eyes.' That's to say, I've found a place and I'm going to catch all that I can, even though one day it will run out. Normally when they went fishing, they would bring back a fair quantity in their *tecomate*[2] *[see Figure 2]*, or maybe in a *moral*.[3] Enough for two, three, four days or even up to a week. Once they've finished that, they go out fishing again. So that's how they normally used to fish. Later there was a time when it was done for commercial purposes, but a long time ago it was exclusively for personal consumption. *(Olivia, fisherwoman)*

Some accounts try to explain the reasons why fish stocks are depleted, and they have to do with the idea that *Achaneh* is upset because the bodies of water she owns have become polluted. The people in the community who see this legend as a reality say that *Achaneh* has not gone away, she is just hidden, and the place she is hiding in is where she has taken the fish. Even today stories are still told relating to the legend of *Achaneh*, they even speak of a place where people believe that she is hiding. In the following account, I share a recent story with the same characteristics of the legend, which happened in the past when the legend was still current.

This account shows how, although the legend is seen as belonging to the past, it is still a current issue for some inhabitants:

> In Estero Mudo *[Silent Marsh]* people hardly go there to fish, well some elders say that many years ago *Achaneh* was all around because she could move about. But as the place where she lived became more and more polluted, she was pushed back until she was in Estero Mudo. They say that's where she went and hid because it's more difficult to get in there. And most people who talk about it, as they say that very few people have gone fishing in Estero Mudo, because it's very deep there. The water lily bed there is a metre or a metre and a half thick, and you don't know if you're walking on water or on land. So it's dangerous to fish there because it's very deep and there are a lot of crocodiles, so people respect the place. There is more variety of fish there, and lots of turtles. I know there are because my brother-in-law has been fishing there. And there's something noteworthy, because he used to go fishing alone and would bring back seven to ten turtles in one fishing trip. But once some people who live in the city heard that Estero Mudo was a good place to fish, and my brother-in-law took them fishing there, but when they got there, they didn't find anything. Later, when my brother-in-law went again by himself, he didn't catch anything and wasn't able to bring anything home to eat. So the old men here told him, 'The thing is, *Achaneh* used to give them to you because you have limited economic means. *Achaneh* gave them to you because you needed them, but you brought rich people who have buses, they have cattle, they have land and live in luxury, well of course she wasn't going to give them any fish. Then, as you brought them, so *Achaneh* punished you and took away her fish.' I don't know if it's a coincidence, but that really happened. *(Roberta, fisherwoman)*

Other more or less contemporary accounts agree with the idea that *Achaneh* now lives in bodies of water that are hard to reach. In the following account, it is claimed that *Achaneh*'s messages are still heard; especially with recommendations to avoid polluting the bodies of water:

> There is a river in the community that's about nine metres deep and there are lots of crocodiles there, you can still fish there, but only from the bank. And there's a place there where the elders say that *Achaneh* was there, because that river in the dry season is cut off, but when it's full it's very deep and there's a place where it joins a lake through an underground river. There in that underground river is where *Achaneh* lives now. We heard about an old man who had some land there near the lake and he lived there for a while; he heard in dreams that people shouldn't tip soapy water into the lake and that they should stop dirtying it. And when he went fishing, she would talk to him, *Achaneh* asked the man for his ribbon and his *mamey-zapote* seed oil; once she revealed to him that if he told people they weren't to pollute the lake, she would give him a present when the rainy season began. He did what he was asked, and she rewarded him with very big fish. *(Felícita, fisherwoman)*

Figure 2. Fisherwoman with her *tecomate*
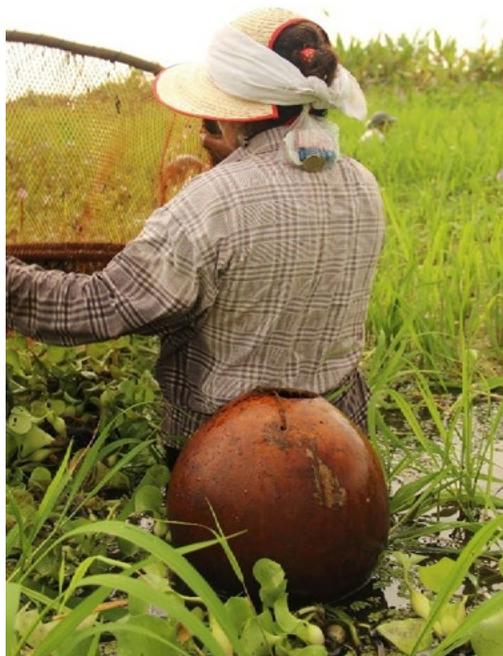
Source: Author

By way of a conclusion

Education is a key element within the framework of the SDGs in indigenous peoples' transition towards sustainability; however, the models, political basis and forms in which education has been delivered in indigenous contexts have not been pertinent, nor have they addressed indigenous peoples' demands and needs completely. Something similar can be foreseen regarding the implementation of the SDGs if indigenous knowledge, their history and their world views, are not taken into account, or if they are only superficially taken into account. There is enough evidence (Toledo, 2003; Shava, 2013; Smith, 1999), besides that presented in this article, of the wealth of socio-environmental knowledge in indigenous narratives that should be considered as the basis for the development of educational proposals concerning sustainability. In the framework of the SDGs, it cannot be ignored that indigenous communities have developed sustainable local practices based on their own systems of knowledge and beliefs. In this way, it is worth taking up the ethno-ecological knowledge encrusted in the daily practice of indigenous communities, because it cannot be denied that their traditional systems are still fundamental for transitioning towards future sustainable conditions. Similarly, the recognition of and respect for these systems of knowledge, together with support for their continuity, should be fundamental aspects in the design of solutions to the socio-environmental challenges facing us as a species. Therefore, there is a need to encourage the transmission of this knowledge and

a need for its inclusion in formal education. The evidence presented in this article, based on the accounts of the fisherwomen of Zaragoza, lays the basis for demanding the implementation of the SDGs in indigenous contexts through existing local knowledge, and not just through exogenous knowledge and/or global frameworks.

The reflections presented here are the first steps towards future studies that could be carried out, in greater depth, to understand the way in which meaning is constructed in indigenous communities from situated narratives, the way in which it is passed on, the educational potential that lies in this indigenous knowledge and these narratives, and the risks involved in allowing these practices to lapse in the daily life of communities.

Endnotes

1. See https://sustainabledevelopment.un.org/sdgs
2. A kind of calabash, originally from Africa, from which jars and musical instruments are made.
3. A woven bag or sack (made of plastic or organic materials) used to carry a range of products.

Notes on the contributor

Sandoval-Rivera | Juan Carlos A. | Universidad Veracruzana, Mexico
ORCID 0000-0001-8084-282X | jcsandoval.rivera@gmail.com
Through audio-visual collaborative research methodologies, the author researches and supervises educational research projects on the interaction between indigenous knowledge and scientific knowledge in socio-ecological processes and the adaptation to climate change in indigenous contexts.

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Landscape, memory and learning to change in changing worlds: Contemplating intergenerational learning and traditional knowledge practices within social–ecological landscapes of change

Rob O'Donoghue, Juan Carlos A. Sandoval-Rivera and Unnikrishnan Payyappallimana

Preamble

The core paper and collection of short papers from Mexico, Africa (Zambia and South Africa), India and Sweden that make up this study on social–ecological landscapes developed as a South–South collaboration that was extended to include a case in the North. Our concern was to explore how situated, intergenerational knowledge commonly takes a back seat to the conceptual propositions that the environmental sciences have developed around matters of concern like biodiversity loss. In this way, scientific propositions have become the conceptual capital for informing future sustainability through Education for Sustainable Development (ESD). In response to this, a more situated turn has developed to engage both intergenerational practices and the institutional sciences, but the playing fields are seldom level and deliberations are often rife with misunderstandings.

Current trajectories of social–ecological change were already evident at the turn of the 20th century where one found the colonial oppression of indigenous peoples and early manifestations of accelerating environmental degradation. The latter escalated into biodiversity loss as a global concern that both underpins and resonates with the current complex of global risks. This concern has shaped education imperatives towards learning-led change so as to reduce the risk of catastrophic problems such as climate change and ocean acidification, for example. These and other critical sustainability concerns have developed as planetary limits are being exceeded on a widening scale. The associated patterns of change and escalating risk in the modern era have played out in each of the regions where our teams of authors have researched their short papers on social–ecological change and intergenerational learning. The papers are intended as contributions that might better situate indigenous peoples on their intergenerational lands in reflexive learning within a rich mix of ancient and modern scientific ideas and ideals.

Each contributing team of writers offered to develop a short case study to illustrate how intergenerational patterns of practice have shaped long-term sustainable landscapes in their regions. We noted how much of the intergenerational knowledge was marginalised during colonial modernity, which generally denigrated and discounted the knowledge of the oppressed against the dominant institutional hegemonies and the omnipotent objectivity of the sciences. To inform our work, we loosely drew on the 'history of the present' processes of Tom Popkewitz (1988), who points to how education imperatives to change The Other developed in ways that

did not consider how: 'The identification of culture in pedagogy is never free-floating but occurs in a context of power relations' (1988:80).

The opening core paper explores issues of knowledge and power and the case study papers from Mexico, Africa, India and Sweden that follow each exemplify implicit knowledge practices. These have shaped intergenerational landscapes that have been radically transformed within colonial modernity and the marginalising expansions prevalent in recent globalising trajectories. Each of the papers opens up some of the contours of intergenerational knowledge practices to explore how indigenous custodians of the associated knowledge are implicated in patterns of practice that have shaped landscapes over time. Against these, the attendant contradictions emerging in modernist globalisation and reflected in the Sustainable Development Goals (SDGs) cannot simply be read using expert analysis or be contemplated against global ideals generated with the abstract concepts of the environmental sciences. The depth of historical wisdom and its intergenerational custodians must enter the sustainability game as key players towards attaining more just and sustainable futures.

In contrast to the concerns and perspectives that one commonly finds in ESD, people engaged in intergenerational learning are foregrounded here along with what they know and what is going wrong in the world around them. This approach to reflexive learning invites intergenerational story sharing as a starting point for raising concerns and for engaging with useful knowledge that modern sciences generate to help us steer our continuing learning towards future sustainability. It also shapes the somewhat unusual approach to this collection of papers.

The core paper opens with a provocative statement borne of a decolonial perspective (Maldonado-Torres, 2007) that sees abstractions within the Arcadian idealism underlying the ecological sciences as not adequate against the intergenerational nuance of situated cultural practices. It addresses these questions in terms of the sophistication that intergenerational accounts and social-ecological perspectives can bring to learning alongside the object congruent knowledge and risk surfaced by modern environmental sciences. A Post Script explores touchstones on situated competence, deliberative learning and ESD as co-engaged processes of learning-led change.

Around these insights and standpoints, the papers assembled through collaboration invite us to contemplate traditional ecologies of knowledge and intergenerational action learning within social-ecological landscapes of change.

Abstract

This study contemplates the interweaving of knowledge practices within social-ecological landscapes of change. In doing so, it takes a position that indigenous peoples should not be too readily enticed into being identified as traditional custodians of nature within western ecological abstractions when they have their own histories as intergenerational creators of, and curators in, mosaic landscapes of biocultural diversity. The review explores how traditional social-ecological knowledge has seldom been explored as integrated within seasonal cycles or as ecologies of knowledge[1] that have shaped social-ecological landscapes in diverse biocultural regions. Here, key aspects of the intergenerational cultures embedded in long-term sustainability practices have shaped and sustained social-ecological landscapes into the era of modern capital. The core

paper that follows proposes that exploring the intergenerational knowledge practices implicit in local cultural landscapes can be a key positive dimension for shaping learning-led change in a modern era of widening environmental degradation and biodiversity loss.

Five short case study papers are coupled with this study. They reflect some of the dimensions of intergenerational ecologies of knowledge that are evident within biocultural mosaic landscapes in:

1. *Mexico (Zongolica, Sierra Grandes Montañas –* milpa*);*
2. *Zambia (Miombo Woodland –* chitemene*);*
3. *South Africa (Zululand savannah grasslands – Nguni cattle);*
4. *India (Western Ghats monsoon forests – sacred grove rice-lands);*
5. *Sweden (Vattern Scarp – meadow pastures).*

The narratives were compiled as brief case studies at the intergenerational landscape level in each of the countries. Each case narrative is situated with a photograph of the macro landscape and with a photo of the intergenerational heritage practices that have had shaping effects within the social-ecological landscape in question. The case materials point to insights that have the potential to enable restorative and re-imagining possibilities for future sustainability. The short case studies locate people and their intergenerational practices in relation to modern landscapes of change. Here the writers reside as dialogical partners working in more inclusive and reflexive learning-led change. Some dimensions of the intergenerational practices that have been sustainable over generations have been implicated in modern patterns of change that have become drivers of environmental degradation in the modern era. However, much of the indigenous common sense is commonly overlooked.

The case studies are intended to open up and refine social-ecological insights in relation to the complex intergenerational relational dynamics amongst cultures and landscapes.

> [W]hat could be legitimately asked is to what extent some kind of 'practical' abstraction, conceived of as a strategy of generalisability and an experience of interconnectedness, is actually needed for emancipatory anti-capitalist politics to counter the divisive and singularising instances that proliferate in the camp of the oppressed. *(Muscat, 2011:43)*

Background

In our interacting work of the last few years, we have visited numerous sites where cultural practices have been situated in, and have shaped, social–ecological landscapes over many hundreds of years. These landscapes were also undergoing rapid change that accelerated with modernity to threaten future sustainability of both indigenous cultural capital and the landscapes sustaining this. It struck us that there was much to be learned across the cultures involved and the modern ecological sciences that were increasingly being used as a source of concepts and perspectives to assess degradation and to call for learning–led change to reverse current cycles of environmental disruption and decline.

The experiences that brought us together as a writing team were diverse. Rob O'Donoghue was inspired by the works of Erach Bharucha (2016, 2017), which explored the diverse cultures

and landscapes of India. These elevate situated and scientific knowledge to the landscape level and raise open questions about learning-led change and future sustainability.

Juan Carlos A. Sandoval-Rivera is developing a research programme inspired by fieldwork where the cultural capital of indigenous peoples and the ecological sciences interact in the generation of new knowledge for informing future sustainability. Here he is working with the indigenous research agenda after Linda T. Smith (1999) that is orientated to the self-determination of indigenous peoples. He has noted an affirming and deepening of traditional knowledge practices especially where knowledge systems were deployed in collaborative learning at the nexus of local concerns.

When Unnikrishnan Payyappallimana asked us to explore these ideas in print, we decided to work with him and invited multi-site writing teams to participate so that the landscape-level cases examined might provide insights into the co-shaping of cultures and landscapes over many generations. This study and the collection of short case study papers is an attempt to open up conversations that might inform and expand the scope of ESD as co-engaged meaning-making at the level of future landscapes for human flourishing.

A tension shaping the impetus to develop this paper was a realisation that the ecologies of conservation science and the ecologies of knowledge in traditional intergenerational settings have seldom interacted on a relatively level playing field. A recent advance has been the instituting of 'participatory mechanisms' in the Convention on Biological Diversity and the Intergovernmental Panel on Climate Change (IPCC). It is notable how the Scientific Advisory Board of the United Nations has recently made policy decisions that

> recognize Indigenous and Local Knowledge(s) as complementary to Science(s) and integral to knowledge-policy platforms on sustainable development, biodiversity and climate change. (UNESCO, 2016:1)

The concepts and perspectives of environmental sciences have been dominant in framing the concerns and steering the international environment and sustainability agendas; intergenerational indigenous perspectives have seldom been prominent beyond a recognition of the need for social justice. We hope that this study and the writings from Mexico, India, Zambia, South Africa and Sweden will exemplify how knowledge in ongoing generative movements that Ingold (2010) notes are at once 'itinerant, improvisatory and rhythmic' emerges as generative processes of intergenerational innovation. The gaze of the review is thus centred on intergenerational knowledge contexts to exemplify how a plural capital of situated social-ecological knowledge is foundational in reflexive learning to reimagine more sustainable futures together.

Traditional ecologies of knowledge

As environment and sustainability problems emerged within the accelerating trajectories of consumption in the modern age, it became popular to inscribe indigenous peoples as custodians of nature. In early environmental education in southern Africa, for example, this role was

ascribed to the Bushmen, the first nations San peoples, and also to the Khoi-speaking peoples of southern Africa (O'Donoghue, 1998). Ironically, indigenous peoples of Nguni origins were initially bracketed out. Would these early peoples have agreed on the notions of ecological harmony and holism that they were said to pass down from generation to generation?

As the role of situated cultures as custodians of traditional ecological knowledge was extended to many indigenous peoples all over the world, some entered the conversation, but many also experienced intractable contradictions. A double-bind paradox in southern Africa was that indigenous peoples were doomed to fail in the nature-centred discourses of ecological sustainability. If they gave up lands to conservation, they seldom had adequate access and skills to manage the international tourism economies that were to provide alternative income streams. Here their cultures became either performative for the entertainment of others or were lost against the ecological idealism of natural wonders devoid of, or set against, the excesses of human exploitation. The conservation and tourism economies were also tenuous and fragile given the footprint of global recreational travel along with the associated health and safety considerations that set the tourist apart. If indigenous communities did not buy into setting aside conservation lands, then their patterns of ecological consumption were commonly excluded by colonising laws framed around the economic self-interests and the Arcadian ideals of the colonising nations and environmental management regulations.

This study sought to avoid the paradoxes of Arcadian ecological idealism and clear the ground so as to open up the prospect of co-engaged meaning-making at the landscape nexus of traditional social-ecological knowledge practices and modern environment and sustainability science knowledge. To begin these conversations towards learning-led change for transitioning to future sustainability, the paper concludes by giving attention to the possibility of increased learning at the nexus of landscape and intergenerational heritage practices.

The emerging ecological legacy of the natural sciences

Latour (1999), in his *Pandora's hope*, illustrates how scientific environmental knowledge was constituted as 'time saving abstractions' within circular dialogical processes between laboratory and field. The abstracted concepts developed were useful to those privy to the emerging symbolic capital that enabled participants to signify reality and to predictively model and agree on explanatory insights in relation to the workings of natural systems and processes. In this way, scientist observers were able to constitute new environmental knowledge about nature and to begin to use an increasingly object-congruent capital to resolve emerging matters of concern.

Shava (2008) illustrates how much of the early explanatory capital in the natural sciences in Africa initially drew on knowledge-sharing interactions with indigenous peoples. The indigenous people were then seldom privy to the scientific concepts developed within the prevailing colonial perspectives. Here, knowledge was accumulated in a foreign language and was constituted as disciplinary fields that came to be held in, and dispensed from, modern scientific institutions. In this way, new scientific knowledge was usefully accumulated as reality-congruent perspectives within disciplinary fields in scientific institutions and was increasingly

put to use in the expert reading of concerns and in the development of propositions for the resolution of conservation and sustainability problems.

The ecological sciences were thus deployed and developed in the explanatory modelling of risk. This reflexively made human–induced environmental degradation more explicit to experts. Widening environmental change and deeper expert insights into how humans were impacting natural surroundings began to give rise to calls for education to create the necessary awareness of the impacts of human activities so that new and more sustainable patterns of practice might be developed.

This process account of knowledge relations between indigenous peoples and the natural sciences serves to illustrate how the production and control of a useful kind of reality–congruent knowledge became vested in the modern sciences of the state. It also illustrates how the accumulating knowledge was constituted within particular patterns of control and through the exercise of state power and the ideals of the times. The ideals in many African contexts of colonial expansionism were those of Sylvain harmony in nature (Sharma, 1995) and an appropriating control of land and its resources[2] by capital.

As a response to increasing state hegemonies, Kincheloe and Steinberg (2008) point to the need for the inclusion of indigenous knowledge as a way to counteract the destruction of the planet that the western sciences have shaped. They note that indigenous knowledge can help to counteract the current poly–crisis because of its focus on the relationships that exist between human beings and their ecosystems. This aspect has, until recently, been absent in much of the knowledge produced within the empirical canons of western science.

The dialogue between scientific knowledge and indigenous knowledge requires recognition of the existence of indigenous cultures as producers of valid knowledge that has been constituted over generations but seldom in dialogue with western knowledge. In this sense, in order to foster a dialogue like the one mentioned, it is necessary to identify the 'cultural pedagogies' (Kincheloe & Steinberg, 1999) at play shaping situated knowledge practices and to contemplate these as processes of intergenerational knowledge production that have shaped livelihood practices and landscapes over time. Intergenerational 'cultural pedagogy' refers to

> education that takes place in a variety of social settings, including, but not limited to, school. In our opinion, if we want to make sense of race, social class, and gender and their relationship to the socio-educational process, our work as cultural and educational scholars requires that we study, in addition to school, the cultural pedagogy that takes place outside of it. *(Kincheloe & Steinberg, 1999: 32–33)*

It is possible to note how the relational dynamics and ideals of colonial modernity took little note of these and education has generally functioned within patterns of exclusion that were centred on enabling access to the propositional knowledge of academic subjects. The histories of colonial knowledge appropriation and marginalisation established the ground rules for modern education and an emerging assumption that the scientific drivers of modernism could be reversed through the deployment of ecological reasoning in environmental education. The history of knowledge appropriation and the exclusions here are a necessary backdrop for

contemplating a return of indigenous custodians of the land and the prospect of restorative effects where intergenerational knowledge practices and scientific knowledge are co-mingled.

The co-mingling of heritage practices of humans and environmental sciences

The study notes that although the environmental sciences have expanded to the landscape level, these are still often underpinned by Sylvain idealism (Sharma, 1995) that has commonly bracketed out human interactions as integral to nature and biodiversity. Ecological narratives in Africa and elsewhere have commonly positioned indigenous peoples on the margins in an exclusionary, globalising modernity and as a key part of the problem shaping biodiversity loss. This perspective has a reality congruence for probing how the expansionism of the modern era has transformed landscapes. It unfortunately often downplays or excludes a human role in the biodiversity of the planet. In recent years, the limitations of the early ecological sciences have been transcended and indigenous peoples are being included in conservation practices, but this commonly happens such that their re-inscription is mediated through the lens of ecological harmonies rather than with a more realist grasp of human co-existence within the malleable seasonal dynamics and resilience of landscapes as biocultural entities. Overlooked also are the historical processes of exclusion, expropriation and exploitation that indigenous peoples have suffered for more than five hundred years and which have shaped the over-exploitation of natural resources for marginalised rural communities to survive.

As the ecological and environmental sciences have recently been reconstituted as sustainability sciences, much of the education work in southern Africa and elsewhere is still drawing on ecological idealism borne of visits to protected areas such as parks, and the notion that humans are disruptors of past natural system harmonies. Challenges to this hegemony are notable in the Southern African Development Community (SADC) region (see Mukute, Marange, Masara, Sisitka & Pesanayi, 2012), but there are few education materials and activities that include indigenous peoples and social-ecological evidence of how cultures and landscapes are co-shaped over time (see Boege, 2008; Burger, 1987; Toledo & Barrera-Bassols, 2009). Insights on colonialism and early indigenous knowledge practices are essential for a grasp of how humans have come to exceed the sustaining resilience of planetary systems and to invite conversation towards balancing adjustments in how we live and do things in the world.

Reynar (1999) proposed that, for a better understanding of the complexity of the world, the more perspectives we can take into account, the better we will be able to mediate our understandings of reality. In this sense, different frames of reference produce multiple interpretations and enable us to contemplate multiple realities. A multilogical epistemology and ontology fosters a distancing from the real, enabling us to contemplate different frames of reference. Starting from this assumption, in the relations between actors coming from different cultural fields can be found complex matrices of interaction, codes and meanings that are taken up in dialogue to inform our understandings. As an example, we have critical pedagogy affirming that there are no simple or privileged ways of seeing the world, not only one way to represent the world artistically, nor a single way to teach science or write history (Jaramillo & McClaren, 2008). In the educational field, once teachers escape the traps of the 'keeper

positivism of the western tradition' (Kincheloe & Steinberg, 2008:139), simplistic thinking, which can be represented by a two-dimensional photograph, is replaced by the multiple angles of a holographic photograph. Stimulated by this 'cubist cognition', educators can understand that the teaching models they have used, the research definitions they have been handling, the vision from which they have been instructing, as well as the learning modes they have been forming, are nothing more than a particular knot in the network of reality (Kincheloe & Steinberg, 2008). The possibility of observing reality critically from a multilogical perspective allows a form of analysis that fosters connections and attends to the context. The conceptions derived from the perspective of the historically excluded make it possible to visualise the power of difference, the processes of oppression and the limitations of the monocultural ways of constructing meanings (Reynar, 1999).

The illustrative case studies that follow are an attempt to explore some of the landscape-level histories of a co-evolution of people and planet. They are intended as starting points to invite conversations that explore the relational dynamics between human practices and evolving landscapes in diverse and interesting parts of the world. They are also done in ways that intermesh the intergenerational knowledge practices of indigenous peoples and the accumulating capital of modern environment and sustainability sciences together to open up pathways for re-imagining futures that are more just and sustainable within a deepening grasp of the resilience of natural systems and processes in a changing world.

These dimensions came to the fore on a recent visit to Norway, when Rob O'Donoghue met Sven Poulson, a landscape and calendar artist whose creative work depicted the mountain cultures of Norway within the seasonal cycles of the *Hardangervidda*. His work allowed us to frame our work on social-ecological systems and elevated our thinking to contemplate landscape, people and the seasonal cycles that integrate cultural practices and the natural world as interpenetrating processes over many generations.

Figure 1. Sven Poulson and his depiction of the seasonal cycles of the *Hardangervidda*

The social-ecological dimensions of his work resonated with the seasonal cycle calendars of Mexico and the monsoon cycle of the Western Ghats. Rob had the pleasure of working with Juan Carlos and being introduced to the intergenerational knowledge practices related to the *milpa* of Zongolica (Case study 1) with Citlalli, Belinda, Fortunata, Helio and Mark earlier that year. A few years prior to that, Rob had visited the sacred groves of the Western Ghats (Case study 4) as well as experiencing the Vattern Scarp landscapes of Sweden (Case study 5). In recent work on climate change, he was introduced to the long-term *chitemene* in Zambia (Case study 2) after earlier having conducted his PhD on the conservation practices of Zululand in South Africa (Case study 3). The cases thus self-selected out of the experience of working with leading environment and sustainability educators learning in local environments in co-engaged ways.

Our shared experiences and the substance of these cases pointed to common ground in learning interactions, namely how people and landscape 'spoke to each other' revealing many generations of sustaining practices that have been disrupted in colonial modernity around the world. Here, our common interest in education and learning-led change pointed to the importance of integrating ecological perspectives with intergenerational knowledge practices in learning with custodians of traditional ecological knowledge who are working the land in reflexive ways in times of change.

Endnotes

1. Interdependent cultural dispositions and social-ecological practices developing over many generations. See De Sousa Santos (2007) on 'ecologies of knowledges'.
2. There are attempts such as the community protocols and biocultural protocols, which are newly emerging positions within the global policies against this state control. See https://www.cbd.int/abs/text/articles/default.shtml?sec=abs-12
3. Custodianship here implies both an intentional shaping purpose and a more blind mediator of desired effects. It is notable how the Nguni burning practices served to both create cattle lands and exclude the risk of wildlife or how the sacred forests of the Western Ghats conserved water and provided nutrients to rice plants. Both of these were clearly intended in the indigenous knowledge practices in each case (examined later) that had landscape effects sustained over time and within the seasonal cycles.

About the authors and their contributions

Lead author
O'Donoghue, Rob
Environmental Learning Research Centre (ELRC), Rhodes University, South Africa
r.odonoghue@ru.ac.za
Rob O'Donoghue is an Emeritus Professor at the ELRC at Rhodes University. In his research on environmental education processes of learning-led change, he has given close attention to indigenous knowledge practices, social theory and environmental learning in post-colonial curriculum and community contexts.

Co-author

Sandoval-Rivera, Juan Carlos A.

Instituto de Investigaciones en Educación, Universidad Veracruzana, Mexico

ORCID 0000-0001-8084-282X | jcsandoval.rivera@gmail.com

Juan Carlos A. Sandoval-Rivera is based at the Instituto de Investigaciones en Educación, Universidad Veracruzana in Mexico. Through audio-visual collaborative research methodologies, the author researches and supervises educational research projects on the interaction between indigenous knowledge and scientific knowledge in socio-ecological processes and the adaptation to climate change in indigenous contexts.

Co-author

Payyappallimana, Unnikrishnan

United Nations University-International Institute for Global Health, Kuala Lumpur, Malaysia

payyappalli@unu.edu

At the time of contributing to this paper, Dr Unnikrishnan Payyappallimana was working at the United Nations University Institute of Advanced Studies based in India. He currently works at the United Nations University-International Institute for Global Health, Kuala Lumpur. His main research interests include traditional medicine in health systems, public health, medical pluralism, traditional knowledge epistemology, science–policy interface and sustainable development.

Percentage contributions

Areas of contribution	Authors	Percentage contribution
Conception or design of the paper, theory or key argument	O'Donoghue	50%
	Sandoval-Rivera	25%
	Payyappallimana	25%
Data collection	O'Donoghue	50%
	Sandoval-Rivera	25%
	Payyappallimana	25%
Analysis and interpretation	O'Donoghue	50%
	Sandoval-Rivera	25%
	Payyappallimana	25%
Drafting the paper	O'Donoghue	50%
	Sandoval-Rivera	25%
	Payyappallimana	25%

Areas of contribution	Authors	Percentage contribution
Critical review of paper	O'Donoghue	*50%*
	Sandoval–Rivera	*25%*
	Payyappallimana	*25%*

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Case study 1: Mexico

Zongolica, Sierra Grandes Montañas – *milpa* and forests
Citlalli López-Binnqüist, Belinda Contreras-Jaimes, Fortunata Panzo-Panzo, Helio García-Campos and Mark K. Stowe

Figure 2. Landscape with patches of pasture, forest, pine plantations and *milpa*.

Source: Belinda Contreras-Jaimes

Figure 3. Harvest of maize – part of the management of *milpa*.

Source: Fortunata Panzo–Panzo

Figure 4. Offerings in the *milpa*. Intergenerational heritage practices.

Source: Fortunata Panzo–Panzo

Figure 5. New types of diversified management – interspersing maize and pine.

Source: Belinda Contreras-Jaimes

The Sierra de Zongolica is a mountain range inhabited since pre-Hispanic times by Nahua people. The current population includes 200 000 speakers of the Nahuatl language, and it is a region with a strong indigenous cultural identity. Known locally as 'the Great Mountains', the dramatic karst landscape ranges in altitude from 500 to 3000 m above sea level. The region can be divided into three zones: warm (lowest), temperate and cold (highest). The cold zone, (*Tlasesekya* in Nahuatl), where this case study is located, is a mosaic of various intensities of human use, including pine-oak ecosystems in different successional stages, pasture patches for sheep grazing, pine and mixed crop plantations, and housing areas.

These agro-forestry systems are based on a fine understanding of the management of vegetation in different growth and regeneration cycles. Maize (*Zea mays*) was domesticated in central Mexico and constitutes the most significant and emblematic Mexican biocultural heritage. For thousands of years, it has been the mainstay of agriculture in Zongolica. This grain is grown in a traditional system of production known as *milpa*, which cycles between maize, squash and beans, and includes the management of weeds, trees and fauna. It depends on letting the land rest for regeneration and using short or long production cycles with a diversity of perennial and annual managed species that include domesticated species, cultivated wild species, and tolerated (and then harvested) weeds. The management of the *milpa* constitutes a body of practices, knowledge and spirituality that has been transmitted through the generations to this day.

Milpa involves 'tillage and burning', which makes it a form of transhumance (shifting cultivation) agriculture. Because of this, the forest and the spaces dedicated to agriculture in vast regions of the Eastern Sierra of Mexico maintain a delicate balance, with a hydrological cycle that shows significant resilience.

Historically the use of various timber and non-timber forest resources has been a part of Nahua daily life, providing food, dyes for textiles, fuels, medicines, and more. The commercial exploitation of wood for sale as a raw material or transformed into rustic furniture (the main timber product of the region) is a more recent practice. Commercial timber harvesting emerges as a practice distinct from local management traditions, one heavily influenced by external agents and market forces, but also adapting to coexist with the local ways of life.

Two historical events resulted in excessive extraction of wood with an impact on the forests of the region. The first was the Second World War, and the second arises from a national policy that allowed logging concessions and open access without regulation for the extraction of wood as a raw material for railways and mines. The abuses that resulted from this policy led to a total ban on logging in most of the mountain forests in Mexico. But this ban was not enforced in Veracruz, Huasteca or Zongolica, leading to intense clandestine deforestation (often accompanied by violence) conducted by intermediaries from outside the Sierra.

It was thanks to the mobilisation of the Nahua population that control over the forests was regained. Subsequently, various government initiatives, including commercial programmes of pine plantation and reforestation with *Pinus patula* have been carried out. These programmes have impacted the management of family plots and the landscape – with wood as a source of household income sometimes beginning to compete with maize. In the face of this, in an innovative manner and as an expression of resistance and resilience, the peasants are exploring

ways to maintain the *milpa* by integrating in them the growth cycles of pines and other useful trees and plants. This allows the generation of income and various products for self-consumption. Unfortunately, it has also led to a decrease in biodiversity – since the government does not favour local cultural values and the growth of native trees that have more uses. On the other hand, the inhabitants have noticed and appreciated the environmental benefits that have come from increased forest cover, including the decrease of erosion leading to fewer landslides and the restoration of springs. Thus, the landscape reflects tensions and compromises as the peasants use their detailed knowledge of the biophysical conditions to maximise their resources.

In this way, local interest in the cultivation of *milpa*, with its great cultural roots and accumulated millennia of experience and knowledge, is colliding with modern forestry practices, many coming from government initiatives that are not linked to traditional management. This results in new knowledge and innovation, but also the loss of local knowledge when traditional products and their production techniques are displaced. These practices may follow the traditional ways of transmitting knowledge, namely through observation, orality and practice. But this transmission will no doubt be reinvented in the context of school education, globalised communication and the cultural influence of migrants.

This reflection encourages critical questioning and uncertainty about change, especially in the face of a growing gap between local and school knowledge, and in the face of migration, fragmentation of the landscape and external markets. This greater pressure affects a region with a great need as well as great potential for conservation of water and biodiversity, among other resources. This situation highlights the vulnerability of the Nahuas and, at the same time, highlights their ability to adapt.

About the authors

The authors of this case study are part of a transdisciplinary group called Grupo de Manejo Integral de los Montes de la Sierra de Zongolica (MIMOSZ), which was formed in 2010. Their backgrounds are in anthropology, communication, intercultural management and biology. Mainly associated with the Universidad Veracruzana, they have extensive experience in research, teaching and participatory community processes. Their work is linked locally to peasant-based organisations and civil and citizen organisations and internationally to diverse networks, especially People and Plants International.

The group works on the strengthening of local organisations and the conservation of biocultural heritage. They work towards these goals by training local university students and community groups in regional planning, community forest management, handicrafts, environment, agriculture and food sovereignty. They work at the intersection of language, landscape and knowledge transmission.

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Case study 2: Zambia

Chitemene agriculture
Overson Shumba and Felix Kanungwe Kalaba

Ecological setting

It is important to start with an appreciation of the ecological setting in which *chitemene* is practised. The region covers approximately 2.4 million square kilometres of southern, central and eastern Africa where Miombo woodlands predominate. The habitat is characterised by highly weathered and leached forest soils where most of the nutrients are held in the vegetation and humus. The available nutrients are also generated by leguminous trees and shrubs that predominate and serve to fix nitrogen in the soil. The region in which these soils and woodlands are located coincides with Ecological Region III in Zambia, where the climate is tropical with in excess of 1 000 mm average annual rainfall. The Miombo woodlands are thus characterised by having low acidity (pH 4.0–4.5), low soil nutrient levels, low carbon exchange capacities and low levels of exchangeable or extractable nitrogen and phosphorus. As such, the soil is infertile and unsuitable for crop farming. It has required ingenuity for people living in these lands and forests to eke out a living through subsistence agriculture.

Figure 6. Today trees are cut both in *chitemene* agriculture and for charcoal production. Bottom right shows a kiln for curing cut logs for charcoal.

Source: Top row: http://cop21.unicef.fr/mapping/chitemene-traditional-farming-system/.
Bottom row: Authors.

Chitemene *cycle*

It is in such an ecological setting that the woodland-based agricultural system of *chitemene* is practised in the northern provinces of Zambia and in southwestern Tanzania, where the same practice is called *ntemele* (Grogan, Birch-Thomsen & Lyimo, 2013). *Chitemene* (meaning to cut) is a shifting cultivation system in which the cultivators burn the cut biomass and then plant crops in the ashen remains. Essentially, *chitemene* follows a cycle. First, the plot in the woodland for crop farming is identified. Second, the branches of trees are lopped leaving the trunk standing. In its original form, the cut branches and leaves are dragged and piled carefully in the infield area at the centre of the field where they are left to dry. Just before, or at the onset of, the rainy season in October/November, the piles of branches and leaves in the infield are burned, leaving a layer of ash covering the soil (Chidumayo, 1996). Finally, crops are then planted in the ashen infield areas.

This infield area is the garden in which crops are planted for the next three to five years after which the plot is left to lie fallow for a period of up to 25 to 30 years. Grogan, Birch-Thomsen and Lyimo (2013) describe how the fallow period has shortened over several decades due to increasing population pressure, i.e., 25 to 30 years in the 1950s and 1960s, 15 years during the 1970s, ten years during the 1980s–90s, and three to seven years by 2010. In the traditional *chitemene*, crop cultivation followed a pattern. The cropping started with finger millet intercropped with cassava in the first year, then followed by groundnuts in the second year and beans in the third year when cassava planted in the first year is harvested. The intergenerational knowledge and technology of the *chitemene* cultivators evolved out of careful observation and understanding of the environment, weather and seasons. The cycles of land husbandry involving cutting, burning, rotational cropping and fallow periods in *chitemene* have shaped and sustained the local woodland ecosystem and enhanced soil fertility for subsistence crop farming.

A scientific and technological reading of chitemene

The ashen remains from the burnt biomass in *chitemene* raised soil pH by reducing acidity. The soil heat also raises soil pH by 1–2 units (Chidumayo, 1996). For example, we explored the consequences of controlled fires on soil nutrients, leading to an appreciation of the role and value of fire in the *chitemene* system. In our prescribed burning simulation experiment, the soil pH increased from an acidic condition of 5.84 to 7.15. A year later, the pH had reverted towards acidic soil conditions (Mwila, 2013; Phiri, 2014). The ashen remains contained important crop nutrients that included nitrogen, phosphorus, calcium, potassium and magnesium. Furthermore, we have observed some decreases in a number of heavy metal concentrations in the soil, such as copper and cobalt, following the prescribed burning. Overall, the ashen product from burning and *chitemene* thus improved soil suitability for crop farming (Chidumayo, 1996). Chidumayo (1996) observes that the ashen remains improve millet yields by, for example, raising the content of ammonium by nearly double. Further, the heat from the burning biomass kills the bacteria in the top soil, ensuring access to the soil's ammonium without competition from bacteria. *Chitemene* is thus an agro-practice from which it is possible to learn some principles of land husbandry (Thrupp, Hecht & Browder, 1997). It is a mode of

soil fertility management and a biomass–ash fertiliser system (Chidumayo, 1987, 1996); it serves as a mode of weed and pest control, and may help sterilise the soil by killing some microbes.

Chitemene is a form of organic farming where the ashen material from the burnt biomass serves as a natural fertiliser and lime that – unlike inorganic fertilisers such as urea and nitrate – tend to raise soil acidity. It is also an agro-practice that follows a crop rotation system, starting with non-leguminous crop millet. As the nutrients from the ash subside over time in the soil, the leguminous nitrogen fixing crops (i.e. groundnuts and beans) are grown in later years before the fallow period.

Integration of chitemene *knowledge and technologies in modern times*

Chitemene in present-day circumstances is experiencing a decline due to high population numbers and the subsequent pressure on land and forest resources (Chidumayo, 1996; Matthews, 2005). However, we agree with Trupp *et al.* (1997), who observed that 'the knowledge upon which shifting cultivation systems are based offers insights useful to agricultural development strategies'.

As described above, *chitemene* agriculture in the Miombo woodlands of Zambia is a good example of a socio-cultural process involving seasonal timing and soil fertility management in a stable high-rainfall area. This socio-cultural system has patterns of cultural mediation that extend to a cyclical process of around two decades before the cycle is repeated, from the clearing of the field, cropping and then the fallow period. Its basis for learning is direct observation and ecological experience in the environment and the ingenuity to create technologies that enable sustainable subsistence farming in an otherwise infertile soil system. One thus not only had the seasonal activities of around five years for the slash and burn tilling of a home area where children were born, but an extension of this to around 15–20 years. Here for the young to marry, they had to return to the lands of their birth, thereby enacting an extended fallow period for the forest to recover. This cultural cycle served to restore the ecological consequences of the slash and burn agricultural process that not only effected nutrient transfer from biomass to crop in leached forest soils, but also served to control soil pests with heat and smoke associated with the seasonal burning of arable land before planting with the arrival of the rains.

As the numbers of people increased and the forested areas shrank, the *fundikila* system of agriculture was developed as an adaptation of the *chitemene* system (Matthews, 2005). *Fundikila* (meaning to cover) is usually carried out in the fallow site of *chitemene.* There, mounds of grass are made in the field, covered by earth and then left to rot and decompose in the dry season. At the start of the next rains, the mounds are levelled and the planting of crops follows the order in *chitemene,* that is, millet and sorghum, and then legumes or groundnuts in later seasons. The *fundikila* system included seasonal variation in cropping that is now at the heart of the hybrid system that one finds in the same climatic region today as the onset of the summer season rains is now commonly delayed until December. Each successive adaptation has evolved to feed larger populations from the same resource base, but some of the early forest system is now fragmented and at risk. For example, *chitemene* could support two to four people per square kilometre; and the *fundikila* system is able to support 20–40 people per square kilometre (Mansfield *et al.*, 1975, cited in Matthews, 2005).

Conclusion

The *chitemene* and *fundikila* systems are biological methods of managing soil fertility and health, and thus their adaptations represent opportunities for intergenerational learning and sustainability. For example, in Zambia, experimentation in farming with ash and biomass charcoal ('biochar', created by burning biomass in limited air) is yielding promising results (Cornelissen, Martinse, Shitumbanuma *et al.*, 2013). The biochar helps to retain potassium, calcium, magnesium, ammonium, thus reducing leaching. Biochar also appears to help improve the microbe population and microbial activity in the soil that helps in organic matter decomposition and nitrogen fixation in the soil.

This suggests that we cannot value people's traditional knowledge and technologies without unpacking their underlying rationales. In light of the rationale of shifting cultivation (such as in the *chitemene* system), Thrupp and colleagues (1997) proposed an integrated and interdisciplinary systems approach whereby socio-economic, political and agro-ecological factors affecting shifting cultivators are studied and implemented in development and environmental management programmes. This must be respectful of local knowledge and practices that have been resilient for millennia. In sum, the case study makes us appreciate social-ecological systems and the fact that improved management of the environment and natural resources requires understanding the social and cultural relationships that already exist and working with the custodians of this intergenerational knowledge.

About the authors

Dr Overson Shumba is a Professor in the School of Mathematics and Natural Sciences and acting Director for the Centre for Academic Development at the Copperbelt University in Zambia. His research interests include mainstreaming Education for Sustainable Development and socio-cultural behaviours into science education so as to contextualise the subject, maximise its relevance and improve its quality.

Dr Felix Kanungwe Kalaba is a Senior Lecturer in the School of Natural Resources at the Copperbelt University, Zambia. He is an expert in the forest ecosystems of Africa and researches forests as socio-ecological systems.

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Case study 3: South Africa

The Grasslands of Zululand and Nguni cattle cultures
Sibongile Masuku

Figure 6. The Ukahlamba landscape (left) and Bandlalenkosi Pearce (right), teaching a child how to apply medicative salve on a cow

Historically, the grasslands of Zululand were sustained and expanded by the Nguni people, who used circular hunting and driving to clear the pastures of the wildlife that carried the dreaded *nagana* (sleeping sickness) cattle disease. Despite centuries of being herded in close proximity to the warmer riverine Lowveld where *nagana* and wildlife thrived, the Nguni cattle had little in the way of natural resistance to the disease. Like wild game, they had patchwork hides and white underbellies, however. This afforded them some protection against the tsetse fly-borne disease, which was transferred from infected wildlife by the blood-sucking flies landing on the shaded underside of their cattle. Young cattle herders had the knowledge to make dung fires to drive infected wildlife away. In his school diary, Magema Fuze (1859) noted and commented to Bishop Colenso that: 'When they came to the place of others [wildlife] they made fires and let it smoke on the cattle.' The combined effects of the cattle's patchwork colouring, the clearing of pastures through regular hunting and burning and the use of smoke successfully protected the cattle from the disease.

O'Donoghue (1998) uncovers how, as a result of these intergenerational knowledge practices, the landscape of Zululand was slowly transformed into grassland savanna and wooded riverine bush, where the reduced numbers of tsetse fly still managed to breed and from where they were transported into the cattle pastures by wild game. The colonial game laws forbade the Zulu from hunting and burning to maintain their pastures, creating untold suffering when the *nagana* cattle disease spiralled out of control in the late 19th century. The colonial government established fenced game reserves to separate cattle and game, but the reserves soon began to revert back to woodland, which didn't support the ungulates that used to roam the Zululand savanna. In the interests of attracting tourists, game wardens now began to burn the bush and grassland in order to retain the open mosaic landscape necessary for wildlife to thrive. They also had to develop culling (hunting) techniques to maintain game populations that could be supported by the available fodder.

Today, when we look at how the landscape was transformed and sustained by the hunting and burning of the Nguni cattle culture – developed over centuries along with the African Nguni cattle – it is possible to observe patterns of biocultural interdependence that were invisible to the British colonial masters, who created the game parks attracting international tourists to Zululand today. The southern African landscapes were further transformed by fencing the cattle into paddocks where the cattle grazing reduced palatable fodder species, thus reducing grassland biodiversity. Limiting burning, which was considered destructive, encouraged bush encroachment, which further reduced the cattle's grassland fodder and encouraged the cultivation of smaller livestock like goats, which further degraded the Zululand pastures around nature reserves. Degraded rural landscapes now stand in contrast to the 'jewels in the crown' of the biodiversity conservation areas visited by tourists as the nature reserves of today.

Nowadays, in an attempt to improve the quality of natural grassland pasture, there is a return to cattle herding. It has been realised that human cultures create landscapes and that these landscapes can support the carefully managed cultural practices which produce the varied and various human livelihood practices across the landscapes of the world.

It is noteworthy that there are convergences and continuities cutting across O'Donoghue's (1998) and Masuku's (2018) research. Masuku's study of the relationship between people, livestock, the landscape and spirituality today highlights certain intergenerational relationships in some of the rural areas neighbouring the Hluhluwe-Imfolozi game reserve as well as in a communal area called Mpembeni. The Mpembeni communal area was ravaged by drought, seriously compromising the cattle's health and well-being. In Masuku's research, the local elders pointed out the relationship between cattle health, *nagana* and ticks, and how fire was not only capable of minimising the spread of *nagana*, but also killed the ticks that jumped onto the cattle and gave the herders tickbite fever as well. Masuku's study also revealed that some of the rituals associated with becoming a spiritual medium are linked to the cultivation of livestock. The researcher herself experienced a journey into spirituality with a teacher who could access the world of the living and the departed. This spiritual realm was revealed through trance dances and other visitations such as dreams. The spirit presence was celebrated with bloodletting from a goat, food and drink. Becoming one with the spirit also meant not eating certain parts of the cow. Through this example, Masuku shows that the intergenerational learning within certain communities extends beyond the immediately tangible into realms where wisdom can be accessed beyond what is local and perceived to be normal.

The social-ecological and spiritual dimensions of intergenerational learning are therefore evident in cattle as a medium of cultural expression. Here, the evidence of intergenerational learning displays socio-cultural dynamics typical in most communities that have been impacted by landscape changes as well as by more recent climate change, modernisation and diverse and demanding land uses. This has been exacerbated by the fact that the traditional cattle herders, the youth, now attended school. As the primary cattle herders, they learnt cattle herding and how to respond to environmental changes from their elder brothers, uncles, neighbours and fathers, who kept a watchful eye over them until they themselves were knowledgeable enough to share their skills with those younger than them.

A traditional healer for livestock, Gama, described to Mausku how he is widely consulted and how his knowledge has grown to integrate that of commercial veterinary experts. His sons, who travel with him to homesteads where livestock are sick, are sent to collect the traditional medicinal plants critical for treating particular ailments. He proudly related how, when he was on one of his travels, his son of less than ten years of age had diagnosed a calf's sickness by himself and given it treatment. On his return, he found the calf was well on its way to recovery.

Masuku's study also focused on girls' roles in looking after livestock. She found that, in families with many boys, the girls were assigned the task of herding goats. Normally it was the younger boys who looked after the goats as an initiation into cattle herding.

In contrast, prescribed school curricula do not take into account learners' prior learning, experience and skills with regards to herding cattle. This omission creates a barrier of abstract detachment that children must then navigate in their early schooling. There is thus a need for the foundational learnings that come with taking responsibility for caring for cattle to be reflected in schooling.

About the author
Sibongile Masuku was at the time of authoring this case study a post–doctoral scholar at Rhodes University, and her work is mainly in cultural heritage resource management, intangible heritage, environmental education and creative writing.

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Case study 4: India

Western Ghats of Kerala: Sacred forests, rice fields and gardens
Unnikrishnan Payyappallimana

Figure 7. The Western Ghats landscape is characterised by forests that were heavily deforested in colonial times. Despite this, there still remain sacred groves that have been retained and protected by local indigenous peoples.

Source: Author

The monsoon seasonal cycle of the Western Ghats has resulted in trees evolving to survive droughts. To do so, they store nutrients in their leaves, which then drop to the forest floor as the hot dry season progresses. Soon the sacred groves have a thick carpet of leaves, which retains moisture and slowly turns into the humus/compost nutrients that will be washed out of the forests into the fields as the monsoon rains of the next season arrive.

For hundreds of years, the rice fields and gardens of the Western Ghat valleys of Kerala have produced rice and other foods, as well as nutritional and medicinal plants. Nutrients are naturally replenished from the forest groves, which produce humus-rich silt each season. The farmers channel water from the forests into their fields and gardens, where they produce compost and collect animal dung for fertilising their crops.

As a biodiversity-rich region, the State of Kerala has a long, well-documented history of homestead garden husbandry, which includes inventories of the numbers and characteristics of various species and their usage (Kumar & Nair, 2004, 2006; Mohan, 2004; Mohan, Nair & Long, 2007). A 14th century traveller, Shaikh Ibn Batuta, describes how

we came to the country of Malabar which is the country of black pepper. Its length is a journey of two months along the shore from Sindapur to Kawlam. The whole of the way by land lies under the shade of tree […] and in all this space of two months' journey there is not a span free from cultivation. For everybody has there a garden and his house is placed in the middle of it; and around the whole of this there is a fence of wood, up to which the ground of each inhabitant comes. *(Logan, 1981:86)*

The State of Kerala has rapidly urbanised in recent times, with the urban population increasing by 6.5% as large numbers of new towns have been established in the last decade. The region has 60 municipalities and five city corporations. However, even in the midst of urbanisation, several socio-cultural practices, including the dependence on home gardens, have continued. Households have knowledge of and use various plant resources for food, timber, firewood, spices, medicinal products, and spiritual and ornamental purposes.

With respect to the usage of plants for medicinal purposes, a study conducted in a central district of Kerala found that homestead gardens contain around 153 species, with an average number of 36 medicinal plants in such gardens (Mohan *et al.*, 2006). The landscapes and gardens of Kerala have thus nurtured a highly evolved traditional medical culture. Testimony to this usage of a unique, locally sourced pharmacopoeia is its codification in a vast textual literature in vernacular from 1500 CE, as well as the distinctive treatment approaches among Kerala's contemporary physicians. The knowledge has also been well documented in modern medico-botanical documents in Latin such as the *Hortus Malabaricus*, compiled between 1674 and 1703 CE. On one hand there are specialised healing traditions such as these, but on the other, there is also the general household home-garden knowledge, which has been used for preventive, curative and promotive purposes for simple primary healthcare problems, such as fever, upper respiratory tract infections, gastro-intestinal problems (e.g. diarrhoea), dysentery, worm infestations, hepatitis, anaemia, arthritic conditions and certain gynaecological conditions.

In the well-known Kerala Ayurveda medical tradition, the majority of the formulations commercially produced across the state (around 500 of them) are based on this specialised local pharmacopoeia and the use of local resources. Of the 4 680 identified plant species in Kerala, 900 are reported to have medicinal value. Around 400 medicinal plants are used by around 700 active pharmaceutical industries, of which 230 are used widely. Of these, over 75% of medicinal resources are available locally, thus indicating a strong link between the pharmacopoeia and local biodiversity (Payyappallimana, 2010).

Regarding food resources, 142 crops belonging to 43 plant families and 104 genera are grown in these agro-biodiverse systems (Nayar, 2011). Homestead gardens alone host 118 to 128 species, with each garden having between 34 to 38 species. These systems are sustained as a result of biophysical advantages, the conservation of biocultural diversity, product diversification, the non-market values of products and services, and various social and cultural values, including the potential for gender equity in managing the systems (Kumar & Nair, 2004).

The Kerala Land Reforms Act of 1963 redistributed surplus land to landless farmers, and was successfully implemented in the 1970s and 1980s (Guillerme, Kumar, Menon *et al.*, 2011). While this event has been criticised for its negative impact on agri-biodiversity, it has nevertheless had positive impacts in terms of the better use of unused land and stronger landholder participation in land management.

In addition, the Kerala Panchayati Raj and Municipality Act of 1994 formed the basis for decentralised governance, and a peoples' campaign for decentralised planning was organised in the following years. These decentralisation policies, community mobilisation and training in Kerala State have had a positive overall impact on garden development and the maintenance of biocultural diversity.

About the author
Unnikrishnan Payyappallimana notes that healthy ecosystems and biocultural diversity nurture life on Earth and enhance human health and well-being. He currently works at the interface of science–policy and practice in the context of health systems, biodiversity and traditional knowledge in ensuring equitable access to health in local communities.

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Case study 5: Sweden

East Vättern Scarp landscape and sustainable meadow fodder
Åsa Westermark and Mikael Gustafsson

Figure 8. Sweden's early village homesteads were at the centre of meadow pastures in the forested landscape. Today, the Swedish rural landscape is still, in part, characterised by open pastures and fields on sunny, south-facing slopes.

Figure 9. Landscape of meadow pastures. This type of agrarian landscape management is characteristic of most northern European countries. What is interesting about the East Vättern Scarp landscape around Jönköping are the processes of environmental, social and cultural interactions responsible for the creation of the mosaic landscape over centuries. Traditional landscape management has been preserved; and the diversity of fodder plants in the summer pastures has been maintained and is still visible in the landscape today.
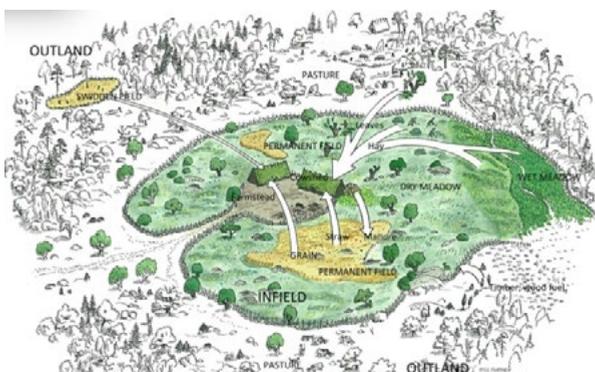
Source: Handout: East Vättern Scarp Landscape Biosphere Reserve, Sweden

The Swedish case builds upon the concept of 'processual landscape' introduced by Torsten Hägerstrand in the 1990s (Hägerstrand, 1993). The processual landscape is dynamic and shaped over time through the interaction between man and nature. The East Vättern Scarp is an example of how traditional management of meadow pastures has been preserved by adapting to physical geographic conditions, and thereby also sustaining diverse land use. Over time, ecological and social well-being have been mutually supported and maintained.

In Figure 10, the diagram on the left shows the landscape from a static point of view. Here, the scenery represents a view of the outcome of processes of change. The diagram on the right describes the processual landscape in terms of the actual processes of change that have contributed to the outcome. These processes of change comprise the natural, social and cultural dimensions that interact over time and in space.

Figure 10. Static and processual landscape views
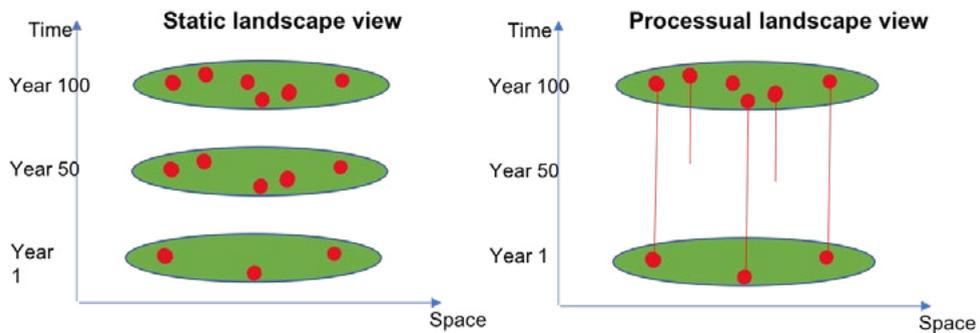
Source: Modified from Hägerstrand (1993:39)

The physical and geographical factors in the East Vättern Scarp landscape are important factors for this long-lasting traditional way of managing the land. In the Scarp and its vicinity, the topography is uneven, and rocky hills with thin soil depth alternate with small valleys with greater soil depth. This kind of terrain causes problems for modern mechanised agriculture. As a result, the area still has a large proportion of relatively small farms, and it is common for the landowner to have more than one source of income, such as agriculture, forestry and other forms of labour. This situation has contributed to the preservation of diversified land use linked to various cultural and social activities.

In the East Vättern Scarp landscape of today, old deciduous trees can be found that bear the traces of *hamling* from the past. These traces occurred when farmers harvested branches with twigs and leaves as winter food for their cattle. The farmers also harvested grass from the meadows for the same purpose. During summer, the cattle grazed on pastures as well as in the nearby forest. The best soil was used for the cultivation of potatoes and cereals. The manure that the animals produced in pastures and stables was used on the fields to grow crops. In the past, it was said that 'the meadow is the mother of crop fields'. In such meadows and pastures, there are biodiverse herb flora, which in today's modern agricultural landscape is increasingly rare. *Hamling* was generally common in southern Sweden until the beginning of the 20th century. Nowadays, this technique of caring for trees is mostly used for cultural purposes and to maintain biodiversity.

At one site in Kabbarp, near the town of Gränna, the endangered elder-flowered orchid (*Dactylorhiza sambucina*) is found (see Figures 11 and 12). This species has been preserved in this area specifically as a result of the meadow and the pasture it offers and, hence, serves as an example and indicator of the important role that this type of environment, in combination with the *hamling* technique, has played in the past – and can therefore also play in the future.

The elder-flowered orchid has inhabited this site since at least 1887 (Edqvist, Karlsson & Christoffersson, 2007). In the map below from 1809, it is obvious that land use was similar then, with meadows and pastures in almost the same places as today, and so it is very possible that the orchid grew there 200 years ago. According to Gustafsson's experience from *in vitro* propagation (Inghe & Tamm, 1988), it takes at least five years for a seed to become a mature plant and, as a result, the species spreads very slowly; however, the plant can grow for more than 40 years.

Figure 11. Map of the Kabbarp property from the year 1809. Meadow and pasture is greenish and cultivated fields are yellowish brown. In the 'Hill meadow' and the 'East of Kabbarp meadow', red circles and ovals indicate where most of the elder-flowered orchid (*Dactylorhiza sambucina*) grows today.

Source: Lantmäteriet. (2018). https://www.lantmateriet.se/

The biosphere reserve of East Vättern Scarp provides insight into the old farming landscape, which in most cases has undergone major changes over the last 50 to 60 years. Today, most pastures in Sweden are planted with forest, or are fertilised pastures producing monocultures. However, in the biosphere reserve, traditional practices have been preserved, and pasture diversity has been maintained accordingly. Harvesting takes place after the annual seed drop, ensuring that the seeds for the next season are already in the ground and ready to germinate after the cold winter season when pastures are covered with snow. To date, the specific shape of the landscape and the traditional farming practices have fruitfully combined economical and sustainable agriculture with ecological sustainability. The purpose of land use has changed over time, from the livelihoods of the past to farming, and then to the preservation of the environment and biodiversity. This transformation will continue, giving way to new opportunities, such as tourism, and, in this manner, the aesthetically beatiful landscape will be passed on to future generations.

Figure 12. Kabbarp farm and elder-flowered orchid (*Dactylorhiza sambucina*)

About the authors

Åsa Westermark is a Senior Lecturer in Human Geography at the School of Education and Communication at Jönköping University, Sweden. Her research interests are in the areas of geography didactics for sustainable development, applying and exploring contextual learning from everyday life, and time-geographic analysis.

Mikael Gustafsson is a Senior Lecturer in Earth Sciences at the School of Education and Communication at Jönköping University, Sweden. His research interests are in the areas of geography didactics for sustainable development and how traditional land-use affects and promotes biodiversity.

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Post Script – Learning and change

Starting points: From sharing knowledge in context to deliberating abstract propositions
The ways in which we learn as individuals and in the company of others in the intergenerational, social–ecological landscapes within which we have grown up are clearly diverse. They are also expanding in modern times with the advent of moving images and social media. In his treatise on the sociology of increasingly reality–congruent knowledge, Norbert Elias (1987:64) noted that

> [t]he method which people use in acquiring knowledge is functionally interdependent with, and thus inseparable from, the substance of the knowledge they possess, and especially from their basic image of the world.

This perspective on social learning resonates with the rich diversity of intergenerational knowledge being carried forward and being changed amongst people living within the social–ecological landscapes depicted in the case studies. It also points to an unfortunately oppressive mechanism of alienation in colonial modernity where the situated intergenerational knowledge that peoples possessed was commonly marginalised and displaced by alienating abstract propositions within modern curricula designed to shape and change behaviour.

It is thus not surprising that many students today are beginning to question and challenge the received curriculum as alienating and irrelevant. The strategies of resistance and inclusive change have been many and varied. On the international stage, the UN Secretary General's Scientific Advisory Board (UNESCO, 2016:2) has exemplified cultural diversity, noting, in line with Elias (1987 above) that: 'The cultures and values of peoples, and the knowledge and innovation within societies are fundamental cultural resources and building blocks for problem-solving and solutions.'

On the curriculum front, there has been a proliferation of new curricula that have been designed to be ethnically explicit. There is also an emphasis on mainstream state curriculum innovations that are attempting to be more plural and inclusive. Neither trajectory of curriculum reform is proving to be wholly satisfying and the terrain of modern education remains fractured and contested as we search for a perspective that is likely to enable situated dispositions and reflexive change in changing worlds.

Working with images and story as 'foundations for awakening ideas'
The intergenerational descriptions in the case studies all start with memory-evoking images and, from an insightful situating of these, expand to learner-led narratives of how intergenerational knowledge practices have shaped landscapes and people over generations. In this way, they provide no more than starting points towards generating 'foundational knowledge for an awakening of ideas'.[1] Working with situated stories and photographic images as starting points for learning together allows people to recognise land that is theirs. Here we can see ourselves surrounded by what we recognise and come to know, and we value things together and in diverse ways. What we come to know and value makes us who we are, with the competence to act in ways that might best provide for us and our families, friends and communities.

We have found that intergenerational stories and photographic images can be very effective starters for ESD conversations. The images invite participants to develop the competence to share their thoughts and to develop internal conversations around their experiences, observations and dispositions. In this way, developing conversations can signify what is important to people and they can build on what is experienced and already known. Here information is shared in the process of reviewing images (simulations and photographs or sketches) through a methodological process of eliciting responses (Harper, 2002) and deliberative learning.

Deliberative learning processes such as this can simply develop from what is recognised. Interestingly, recognition can apply to both contexts that are known (own land) and contexts that are new (others' land). Here images of a known landscape normally evoke accounts of identity and lived experiences as well as respect for the difference of others in different parts of the world. The unknown landscape (the new) can develop through comparative narratives that point to similarities and differences (how our place is similar or different). In this way, intergenerational narratives, photographs and pictures can be great conversation starters for learning transactions, opening up deliberative knowledge sharing. With experience and starting with narratives and photographs that participants bring to learning interactions, it is possible to build competences for ESD processes of deliberative learning as an open-ended human universal value.

Competence to recognise, value and act as a human universal in cultural contexts
In line with this, *competence* in ESD, refers to the knowledge, dispositions and a capacity to act together in ways that enable participants to *recognise* things, *assess* value and *act* on emerging matters of concern (Schreiber & Siege, 2017:91). Feldman Barrett (2017) reports how the cognitive sciences have recently mapped how humans function in the world through predictive simulations that enable us to constitute and mediate our emotions. In exploring the making of our emotions, she describes (2017:153) how: 'Your brain issues a storm of predictions, simulates their consequences as if they were present, and checks and corrects those predictions against actual sensory input.' She also notes (2017:66) how

> through continual prediction [in the mediating company of others], you experience a world of your own creation that is held in check by the sensory world. Once your predictions are correct enough, they not only create your perception and action but also explain the meaning of your sensations. This is your brain's default mode. And marvellously, your brain does not just predict the future. It can imagine the future at will. [Brackets added.]

Time and again we have found that the imaginaries evoked in story sharing, the simulations in the form of pictures, along with mimicry and mime, resonate with and evoke internal conversations where participants can share what they recognise, value and act on to constitute their worlds. In this way, we have come to work with pictures and stories of knowledge practices for inviting participants to share what they recognise, value and do. An emerging theme is inviting participants to identify and exemplify intergenerational ecologies of knowledge as starting points for reflexive enquiry. The deliberative learning processes that emerge resonate

within the social–ecological landscapes of change examined in this study. There is thus still hope for better situated and more collaborative learning as we strive to reimagine better ways of living and learning together in intergenerational worlds of possibility that offer more just and sustainable futures in a changing world.

Endnote

1.   A sense of the importance of intergenerational knowledge practices as foundations for sensing, identifying, situating, expanding and awaken deep ideas was pointed to by many of the case study writers and was vividly expressed by Mikael Gustafsson in this way.

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Living currency: The multiple roles of livestock in livelihood sustenance and exchange in the context of rural indigenous communities in southern Africa

Soul Shava, University of South Africa, and Sibongile Masuku,
Sol Plaatje University, South Africa

Abstract

Modern national and international monetary currencies continue to be the accepted universal media of exchange globally and, to a large extent, have expanded and displaced indigenous currencies and their roles within some community settings. There are, however, areas where indigenous currencies such as livestock (see Schneider, 1964), are considered as the most significant aspect of traditional economies. This paper explores the past and present roles of livestock as indigenous living currency amongst the Nguni and Shona people of southern Africa, mainly drawn from collaborative autoethnography. It further highlights how livestock currencies used alongside monetary ones have sustained and created multifaceted livelihood strategies of such rural area dwellers through intergenerational learning processes. This is against the background of the global economic instability ushered forth by modern economic practices (Karmin, 2008). The paper suggests that traditional 'living' currencies provide a more sustainable economy that enhances the socio-ecological resilience of indigenous rural communities in southern Africa. It also emphasises the need to recognise the coexistence of plural economies beyond the current monopoly of modern capitalist monetary economies.

Introduction

One common feature among the Bantu people of southern Africa was(is) their agro-pastoral livelihoods, particularly how they value(d) livestock and use(d) it as a medium of exchange in trade and other social activities within the Nguni and Shona community contexts. Mixed herds of various forms of livestock are kept, including cattle, sheep, goats and chickens. Animals are ranked according to their value, determined by the extent of their multiple uses. Among these different types of livestock, cattle are regarded as the most important by most indigenous communities (Ainslie, 2002), followed by goats and sheep, then fowls; and, in each species, females are more valued due to their reproductive capacity, while young animals of breeding age are more valued than old animals.

In this paper, the multifunctional role of livestock among the Nguni and Shona people in southern Africa is explored. The Shona comprise a group of people with diverse but related language dialects who comprise the majority of the people of Zimbabwe. In the northern part along the Zambezi Valley are the people of the Korekore dialect, the central part is occupied by the Zezuru dialect-speaking people, to the east are the people of the Manyika dialect (who also occupy the western part of Mozambique), to the southeast are people of the Ndau dialect

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(who also spill over into Mozambique), the Masvingo province to the south is occupied by people of the Karanga dialect, while the Kalanga occupy the southwestern part of Zimbabwe (Matebeleland South), mainly dominated by the Ndebele-speaking people (see Gelfand, 1973, 1979; Gwaravanda & Masaka, 2008a, 2008b). The focus on use of livestock in Zimbabwe was explored among the Korekore dialect-speaking people in Hurungwe. The Nguni–speaking people mainly comprise people of the Ndebele, Shangaan, Swathi, Xhosa and Zulu dialects in southern Africa (Mphande, 1993; Huffman, 2004). The Ndebele occupy the western part of Zimbabwe (Matebeleland North and South) and the northern part of South Africa (the so-called southern Ndebele); the Zulu mainly occupy the area of KwaZulu-Natal, South Africa; the Xhosa are found mainly in the Eastern Cape and Western Cape, South Africa; the Shangaan are found in the Limpopo Province, southern Zimbabwe and Mozambique; while the Swati are found mainly in Swaziland and Mpumalanga Province of South Africa. The Nguni, or Ngoni, also extend into Malawi and Tanzania.

For indigenous communities, livestock was(is) not only a means of subsistence but was(is) interwoven into different aspects of people's everyday lives. It has also signified wealth and food security. Most indigenous peoples have been forcibly incorporated into the global capitalist monetary economy. In indigenous rural communities, livestock are an alternative currency that fills the role that money has in modern capitalist economies (Schneider, 1964). The manner in which cattle, goats and chicken were(are) looked after displayed and continues to display the existence of a complex relationship between the livestock, homestead subjects, their belief systems and socio-ecological becoming. Livestock had and still has social, economic, political, spiritual, as well as ecological significance (see Makamure, 1970; Park, 2013; Tsodzo, 1970). This is not only the case with the Shona and Nguni people who are the subject of this paper, but also with other indigenous cultural groupings such as the Tswana in southern Africa. Comaroff and Comaroff (1990:195) describe what cattle meant amongst the Batswana:

> They linked processes of production and exchange, embodied an order of meanings and relations, and had the capacity to reproduce a total social world. They were, in sum, prime media for the creation and representation of value in a material economy of persons and a social economy of things. But they also had particular historical salience.

The problem that this research addresses is embedded in the observation that money is often the focal point of modern-day life, but it has less significance in the everyday lives of indigenous peoples compared to the livestock upon which their livelihoods are largely dependent. Most of the indigenous communities that are considered 'poor' in modern western capitalist monetary terms survive on a thriving alternative non-monetary economy based on a multifunctional and living indigenous currency in the form of their livestock. This is more so compared to the instability of the monetary currency which can be suddenly eroded with major implications for the families' livelihood sustenance and future security. The multiple roles of livestock as living currency within indigenous communities is explored drawing from our lived experiences as community members within the Nguni and Shona peoples and drawing on literature from other researchers. Collaborative autoethnographical reflections of the authors and review of the

literature were used as sources of data. The multiple uses of livestock species within indigenous communities were revealed, including their role as wealth, livelihood security, gifts, clothing (garments), traditional payment, trading currency, *lobola/roora* (dowry), and in spiritual rituals and ceremonies.

The findings reveal that indigenous livestock continue to be used as relevant living currencies among Shona and Nguni indigenous peoples and provide a more stable and holistic mode of exchange within these communities that ensures self-reliance. However, we acknowledge that environmental degradation, emerging environmental crises, such as climate change, industrialisation and rapid urbanisation, may pose challenges to livestock as indigenous currencies and their multiple roles within indigenous communities. In drawing attention to the presence of alternative economies to the dominant modern capitalist monetary economy, we argue for the need to rethink the conventional perception of an economy as being modern, capitalist and monetary and to embrace the coexistence of plural economies.

A description of the research approach, the emerging narratives and ensuing discussions and conclusions will be dealt with consecutively.

Research methodology

We (Masuku, 1999, 2018; Shava 2000, 2008) have worked on indigenous knowledges as peripherised knowledges over time, exploring their roles in environmental education processes. Our research interests have grown with the intention of further exposing the less-recognised understandings that are generated within indigenous community contexts, most particularly within rural settings. Intergenerational learning has a particular role (Masuku, 2018). In line with this background, this study draws on the decolonial research paradigm, as referred to in this article, in that it challenges the taken-for-granted capitalist monetary economic mode, which marginalises and excludes other economic systems. We affirm and bring attention to alternative non-monetary local economies that are both functional and sustainable in southern African indigenous community contexts. Decoloniality encompasses aspects of critical theory, postcolonial and anticolonial theory in that it aims to challenge the effects of imposed colonisation and continuing coloniality in the 'Global South' and to dismantle the hegemonic western/capitalist/Euro-North-Ameri-centric epistemologies, systems, processes and agendas through delinking from coloniality by shifting the geography of reason, the locus of enunciation, from the Global North to the Global South (Mignolo, 2011; Maldano-Torres, 2011). Decoloniality is therefore not confined by disciplines in its approach and its agenda is explicitly critical (a critique of coloniality) and transformative (the development of alternative models/perspectives). Decoloniality is both an epistemological and political movement (Ndlovu-Gatsheni, 2015); it is a continuous process of epistemic and political emancipation in which indigenous epistemologies, ontologies, pedagogies and practices play a central role. Decoloniality is reflected in a growing body of research by indigenous scholars from South America, the Caribbean, New Zealand, Australia, Samoa, Hawaii, North America, Northern Europe, Africa and Asia, among others. In reference to ecologies of knowledge, De Sousa Santos argues that modern western knowledge is based on abyssal thinking in which modern

scientific knowledge (in this case modern western economics) is 'given monopoly of universal distinction between true and false, to the detriment of alternative knowledges' (De Sousa Santos, 2007:47). Alternative knowledges such as indigenous knowledges are deemed as non-existent (made invisible) and excluded in many modern western knowledge discourses because they do not conform to the western frame of thinking. The marginalisation and exclusion of indigenous knowledges by colonising and hegemonic western/modern/Euro-North-Ameri-centric knowledge discourses and its prevailing negative impacts on indigenous peoples across all spheres of their lives (including their knowledge, pedagogies, languages, lands, resources, economies, histories, politics/sovereignty (rights and freedoms), spirituality, cultures and practices) have been noted by many indigenous scholars (including Dei, 2000; Dei, Hall & Rosenberg, 2002; Masuku van Damme & Neluvhalani, 2004; Shava 2000, 2008, 2013, 2016; Shiva 1993; Smith, 1999). This includes the marginalisation of indigenous modes of economy that do not conform to the modern capitalist monetary economy.

As a process of rupturing the hegemony of modern conventional monetary economic models through an 'insurrection of subjugated knowledges' (Foucault, 1980:81), this article posits that there are resilient and sustainable African-centred alternatives to modern capitalist economic systems that are a living reality within indigenous community contexts, and that these two economic systems coexist, thereby alluding to the plurality of economic systems and knowledge systems in general (Shava, 2013). Interestingly, whenever an economy is self-sustaining and does not conform to capitalist modes of production and monetary currencies, it is relegated to a subsistence economy.

This article is mainly a narrative account that is drawn from our lived experiences growing up and researching in indigenous Nguni and Shona communities that have been corroborated and expanded through informal discussions or interviews with elderly members of our extended families in Zimbabwe (Mashonaland West) and Swaziland. This approach aligns to collaborative autoethnography, which is defined by Chang, Ngunjiri and Hernandeze (2013:17) as 'a qualitative research method that is simultaneously collaborative, autobiographical and ethnographic'. We found this approach a suitable way to narrate our lived experiences on the various uses of livestock. A mixture of planned and random informal discussions/interviews were mainly held with elderly family members from Zimbabwe (three males and two females from Hurungwe, Mashonaland West) during a stay of one month by one of the authors in Zimbabwe in 2016, who were purposively selected due to their possession of livestock and knowledge of them. Most of the discussions turned into informal focus group discussions as other family members would also add their knowledge and views on aspects that were asked about as this usually happened within family everyday activities, such as doing chores around the homestead or sharing a meal, in order to not break the usual flow of activities. Consent was sought and obtained to voice-record the discussions. Member-checking was continuously done by going over summaries of what had been previously discussed, which at times led to additional views and insights. Information was also drawn from a critical ethnographic research project undertaken in rural KwaZulu-Natal. In this area, interviews were held with community members (40 community members with ages ranging from six to 80 years) in Mpembeni, KwaZulu-Natal, as part of broader doctoral research project by one of the authors spanning

three years (2015–2017) with several one-month periods of stay within the community (Masuku, 2018). Interestingly, a similar approach of a combination of planned as well as random chance interviews with knowledgeable community members was employed. Prior informed consent, confidentiality and respect were key ethical considerations during the research process.

The interview data was transcribed, translated (from chiShona and isiZulu into English), member-checked and analysed through coding and sorting into emerging themes. The results were corroborated (triangulated) with our own lived experiences and observations growing up and researching in rural contexts. The resultant thematic narratives discussed below are supported with reference to reviewed literature within the public domain.

Living currencies

The transactional, communal and family uses of livestock and their products vary from one community to another. Based on research data and our lived experiences, and supported by reviewed literature, the emerging uses of livestock as indigenous currencies within indigenous Shona and Nguni cultures are discussed below. We refer to livestock as living currencies because they represent a living mode of exchange.

Livestock as wealth

Within traditional community settings, livestock has always signified the wealth of a man who would jealously guard it as the head of the family as well as instruct others on its upkeep and slaughter (except on trade-related transactions). The larger the head of the family's herds were, the more respect he garnered locally and beyond. This was not solely because of his wealth but also because of his breadth of knowledge, skills and experience, particularly about livestock health, reproduction and upkeep. Attributing his wealth to knowledge meant that he was broadly consulted for this knowledge. However, the advent of colonialism and the imposition of different forms of taxation on homestead members and their domesticated animals altered such practices and associated processes. Men were compelled to migrate from their rural communal areas to take up manual labour tasks that serviced colonialism, such as those generated by the emerging mineral revolution (Magubane, 1986). This warranted the transferral of some of the responsibilities related to the care of livestock to women, who had to take on more responsibilities for everyday sustenance. For women, livestock roles were more restricted to goats, chickens and pigs, and cattle remained the domain of men who were consulted over issues relating to them. With the onset of industrialisation in southern Africa, many men went to work in mines and factories to make money (*ukusebenza/ukuphangela* (Nguni)/*kuenda kumarimuka* (Shona)) so that they could go back to their villages and purchase cattle as wealth. This signified an interface between the modern capitalist economy and the indigenous economy in which both coexisted and had reciprocal valuation.

Comaroff and Comaroff (1990:195) consider cattle as a complex-to-define commodity that fluidly resides in the 'in betweens' of modernity and practices of the past: 'The double character of cattle – as icons of a "traditional" order and as weapons in the struggle to assert control over modern life – has significant implications for our understanding of commodities in

non-capitalist, non-European contexts' . The Comaroffs describe money from the community perspective as 'cattle without legs' (1990:195). This description is consistent with how livestock – and, more particularly, cattle as the most valued of livestock – are considered in this paper. Livestock differ from money in that they are a living source of wealth that reproduces naturally and are not affected by economic fluctuations. Livestock remain a key survival strategy for many rural communities.

Historically, livestock were passed on as an inheritance from the father to the children, and therefore the practice of children looking after livestock was in reality children looking after their inheritance (*pfuma* (Shona)/*ilifa* (Nguni)). Looking after livestock was therefore an intergenerational learning process (Masuku, 2018). Cattle were central to the valuation of one's wealth and social status (Bere-Chikara, 1970; Guy, 1987; Tsodzo, 1970). The importance of cattle is more significant in the culture of some agro-pastoral ethnic groups that place less emphasis on crops, such as the amaZulu, emaSwati and amaNdebele. In the worldview of the community, the value of livestock as wealth is not equated to their monetary/exchange value but to their symbolic value as wealth in themselves (see Doran, Low & Kemp, 1979).

The value of livestock as wealth has been the cause of many wars among the Bantu ethnic groups. Amassing livestock brought men great honour and respect such that some warring tribes, including the Zulu and the Ndebele, have been well known for their cattle raiding activities. The number of cattle that an ethnic group had/has signified political and economic power (Oosthuizen, 1996).

Livestock as livelihood security

Livestock are crucial to the livelihoods of many rural communities in southern Africa and cushion them against risks and vulnerability (Freeman, Kaitibe, Moyo & Perry, 2008). This is more so for communities that live in arid and semi-arid areas of southern Africa where cropping is unreliable, such as in Botswana where livestock rearing is a key economic activity. Besides providing meat, by-products from livestock, such as milk and eggs, are also valuable sources of food (Bere-Chikara, 1970; Dore, 1970; Tsodzo, 1970) and other products (hides, feathers, etc.). Milk (*ubisi/uchago* (Nguni)/*mukaka* (Shona)) was/is usually fermented and made into several products, including: buttermilk (*amasi* (Nguni)/*mukakaka wakakora* (Shona)); cream (*ulaza* (Nguni)/*ruomba* (Shona)); whey (*ulaza* (Nguni); and *umfuma* (Nguni) - a fragrant beauty ointment derived from cream mixed with herbs. These multiple benefits fulfil the Shona proverb '*chirere chigokurerawo*', meaning if you rear (look after) something it will also take care of you. The waste litter from livestock, such as dung (*ndove* (Shona)/*ubulongwe* (Nguni)), has been used as manure to fertilise the crop fields, thereby supporting crop production, and the more manure was available the richer the crop in the fields. In addition, dung was used in plastering the floors (Dore, 1970) and walls of huts in the homestead (*kudzira nendove* (Shona)/*ukusinda ngobulongwe* (Nguni)), thereby making them more structurally secure. Cattle were also used as draught power, providing traction with the advent of the ox-drawn plough, sledge and cart. This cyclical flow of resources is environmentally friendly compared to commercial, capitalistic, inorganic chemical-intensive agricultural systems.

Livestock provide a more reliable livelihood resource. Unlike crops – which are susceptible to extreme weather conditions such as drought – livestock such as cattle, goats and sheep

provide the added advantage to the home in that they are naturally grazed or browsed and can be moved way from areas of drought and shortage of grazing/browsing to other more suitable forage sites. This livestock mobility is probably linked to the origin of pastoral communities in Africa. Livestock can thus be maintained sustainably through migration patterns and are therefore a more dependable source of livelihood. Hall (1986:86) argues that:

> Cattle were more important to farmers because they were a more consistent resource than agricultural produce, and livestock were kept in increasing numbers not because of any adherence to a necessary dynamic of history but because livestock enabled the farmer to insure against future adversity and to establish more secure networks of reciprocity with other households.

The Bantu people had different indigenous breeds of livestock specifically adapted to their local lived environments, thereby enhancing the sustenance of the livestock (see Mwai, Hanotte, Kwon & Cho, 2015; Oosthuizen, 1996). For example, the vaShona have their Shona (so-called Hard Mashona type) cattle, the amaNdebele have their Tuli cattle, while the amaZulu and emaSwati have their Nguni (originally Zulu or Swazi) breeds of cattle. Similarly, indigenous breeds of chickens, goats and sheep are well adapted to local environments. This reveals the extent of livestock agro-biodiversity in the southern African region and its importance to livelihood security due to its adaptation to local environmental conditions.

Livestock as gifts

A common token of appreciation was in the form of livestock (cattle, chickens, sheep or goats). This could be done in appreciation of a service rendered or as a farewell gift to a guest. When a home receives visitors, it is common practice to slaughter a chicken, goat, sheep or calf for them, depending on the livestock wealth of the homestead. A parent would normally give a hen, she-goat, ewe or heifer to a child in order to try their hand in livestock husbandry. Favourite nephews, nieces and grandchildren would also receive gifts of livestock to take back with them when they visited members of the extended family. Gifting children with livestock teaches them aspects of valuing, responsibility and caring for them (Jimenez, 2015). Responsibility for livestock starts with smaller livestock until the children graduate to care and own bigger ones.

Livestock as a source of clothing

Most traditional clothing was made from hides prior to the introduction of cotton, wool and other natural and synthetic clothing materials. The hides (*isikhumba isigogo* (Nguni)/*ganda* (Shona)), mainly derived from livestock, were traditionally processed or tanned (*ukutshuka isikhumba* (Nguni)/*kunyika ganda* (Shona)) until they were soft enough to be fashioned into traditional clothing (*izigqoko/amabhetshu/izidwaba/imisisi* (Nguni)/*nhembe* (Shona)) and sleeping mats or blankets (*ingubo* (Nguni)/*nguwo yekufuka* (Shona)).

Livestock as trading currency

Traditionally livestock have been exchanged in trade transactions for other valuable goods and commodities (Tsodzo, 1970). These include grain, tools and implements (iron axes, hoes,

spears, etc.) as well as modern imported clothing and ornaments (beads) that were traded at trading sites such as Mapungubwe and Great Zimbabwe (see Hall, 1986). Livestock therefore comprised a significant aspect of the material culture of indigenous peoples of southern Africa.

In the modern era, rural communities that still rely on livestock can convert livestock to money when the need arises by selling off some of their animals. However, they still hold on to livestock as wealth due to its multiple functions. The exchange of livestock for modern currency symbolises the zone of transition between the indigenous economy (modes of exchange) and the modern economy, alluding to the coexistence of both economies within indigenous communities.

Livestock as payment (*muripo, inhlawulo*)

Livestock has been used as the main currency of payment in customary law (traditional governance systems) to pacify the offended and to punish the offender (see Bere-Chikara, 1970; Makamure, 1970). The gravity of the case/crime brought to the court (*dare* (Shona)/*inkudla* (Nguni)) determines the type of livestock used in payment of a fine (*muripo* (Shona)/*inhlawulo* (Nguni)) by the perpetrator to satisfy the aggrieved. In these traditional court settlements, the lowest-ranking case would be paid by chickens while the heavier cases were to be paid with herds of cattle. Some cases are not brought to the court but are likewise settled at the extended family level, such as grievances between couples, between family members or between parents and children. For example, among the Shona and Nguni, fines in the form of cows were paid to promote celibate relationships – in the event that a girl is impregnated, the boy responsible has to pay a fine to restore the dignity of the girl. Livestock have therefore played an important mediating role in family and community interrelationships.

Livestock as dowry (*jeredzwa, roora, amalobolo*)

In the traditional marriage institution, *ilobolo* (Nguni) or *roora/jeredzwa* (Shona) was a symbolic appreciation of the bride and respect (*ukuhlonipa abakwabozala* (Nguni)/*kuremekedza tezvara naambuya* (Shona)) through cattle given to the father and mother of the bride by the son-in-law. When the groom's family and messengers (umthunywa (Nguni)/munyai (Shona)) came to ask for a wife (*kukumbira mukadzi* (Shona)/*ukucela umfazi/umlilo* (Nguni) – a wife is associated with the fireplace (umlilo (Nguni)/fire) and bringing warmth and life to the home – the father of the groom and his family would state the *amalobolo* (the dowry in the form of cattle) they required from the bridegroom. The ability of the in-laws to pay *amalobolo* was symbolic of their ability and commitment to look after the bride and the children to be. *Amalobolo* therefore does not imply 'buying a wife' (Chireshe & Chireshe, 2010; Gelfand, 1981; Mangena & Ndlovu, 2013) as is normally misrepresented and misinterpreted in western writings (for example see Schneider, 1964). It instead signifies the cementation of a relationship between the families of the bride and that of the bridegroom, a process that is symbolised by *umshado/umthimba* (Nguni)/*muchato* (Shona) or the wedding feast, where beasts are slaughtered by the in-laws on both sides in celebration of the union of marriage. In traditional weddings, the process took several days, with events at both in-laws, *amalobolo/roora* on the one hand and the reception of the bride (*kutambira muroora* (Shona)/*ukwamukela umakoti* (Ndebele)) on the other. In these reception ceremonies

gifts of livestock (fowls, goats, sheep and cattle), implements, utensils, food, among other things would be given to the bride and the groom to help them start their own home.

In the Shona culture, *roora* is not usually paid all at once as this will be considered a mockery to the father-in-law's family and a taboo. However, certain key aspects of the *roora* had to be paid before the bride was released in symbolic exchange, showing acceptance of the new son-in-law. These included *mombe yeumai* (the mother's cow, valued because it reproduces and gives milk) and *mombe yedanga* (the cow to start the kraal). It was usual for the married couple to set up a home away from their parents. The parents of the groom would occasionally send a messenger (*nhumwa/munyai*) to claim the outstanding bridal price when they wanted to see their son-in law, in which case the son-in-law and daughter will be obliged to pay them a visit. This signifies that the marriage union was not about 'buying the bride' but building relationships. There are therefore the sayings '*kuroora hakuperi*' (Shona), meaning *lobolo* does not end, and '*mukwasha muonde haaperi kudyiwa*' (Shona) – the son-in-law is a fig tree that continues to yield fruit. Lobolo also serves as a form of long-term security (insurance) for the family of the bride in times of need as they can make a claim to the son-in-law on the outstanding cattle.

In the past the father will provide cattle for the *lobolo* (*inkomo zamalobolo/zamabheka* (Nguni)/ *mombe dekuroora/dzechimanda* (Shona)) to the sons, representing a trans-generational transference of wealth, failing which the sons had to individually work and raise capital in order to be able to buy cattle for the *lobolo*. Up to today, the traditional marriage institution of *lobola* is still practised among indigenous people of southern Africa, signifying it as an important cultural heritage practice. The custom of *lobolo* is intended to safeguard marriage relationships against divorce (Bere-Chikara, 1970). However, *ukulobola/kuroora* (traditional marriage negotiation process) has been modernised with the onset of urbanisation, with livestock being replaced with money, bringing with it the negative connotations of 'buying a wife' and the commercialisation of the custom (see Mangena & Ndlovu, 2013; Ngema, 2013). While some of the cattle in the dowry can be replaced with money, ritually there are some than cannot be exchanged with money and have to be presented as live cattle (*mombe dzinotsika* (Shona)/*inkomo ezinyathelayo* (Nguni)). These include *mombe yeumai/yechimanda* (Shona – the mother-in-law's cow) and *mombe yedanga* (Shona)/*inkomo yesibaya* (Nguni – the cow for the in-law's kraal).

Livestock and spirituality

The religious processes of speaking and giving to the ancestors involved the ritual sacrifice offering of livestock (*ukunikela amadlozi* (Nguni)/*kupira mudzimu* (Shona)). Livestock played a mediating role between the living and the ancestral shades. A chicken, goat, sheep or bull could be required of a person or family in order to connect with, or appease, the ancestors. Livestock therefore provided spiritual currency for connecting with the ancestors.

In the Nguni culture, particularly among the Xhosa, the cattle kraal (*intlanti/isibaya* (Nguni)/ *danga* (Shona)) served as a significant site for ritual activities (*ukwenza umsebenzi*) in the home, and a domain occupied by men. This reveals the importance of cattle in linking the living to the ancestors.

In most traditional homes, there was(is) a revered bull set aside for the ancestors (*mombe yevadzimu* (Shona)/*inkomo yamadlozi* (Nguni)) to which traditional rituals of giving to the

ancestors (*kupira mudzimu/ukunikela amadlozî*) were performed (Dore, 1970). These rituals were characterised by the pouring of traditional beer (*doro remudzimu* (Shona)/*utshwala bamadlozi* (Nguni)) over the bull as a libation for the ancestors, usually accompanied by speech of request (*kukumbira kumidzimu/kunevaripasi* (Shona)/*ukucela amadlozi/kwabaphansi* (Nguni)) for the wellbeing of the family. The reaction of the bull to the pouring of the beer onto its head by shaking its head and bellowing was taken as a signal that the ancestors had heard (*kubvuma kwevaripasi* (Shona)/*ukuvuma kwabaphansi* (Nguni)).

Burial of a family member is often accompanied by the slaughter of a bull which is then consumed during the funeral ceremony (Bere-Chikara, 1970; Makamure, 1970). It is believed that this beast will accompany the deceased to the next world, the world of the ancestors (Makamure, 1970).

Conclusion

Indigenous rural communities in southern Africa rely on livestock because of their holistic role enabling them to serve multiple functions that include social, cultural, spiritual, utility, economic and political values. Livestock, as a living currency, provide a means of socio-cultural and ecological resilience that enables indigenous communities to adapt to changing socio-economic and environmental conditions. Such resilience is sustained through intergenerational learning processes and knowledge transfer. Livestock are an economic asset that does not necessarily have to be translated (exchanged) into monetary currency; they are by themselves an independent and living currency with multiple applications relevant to indigenous community contexts. They are a viable alternative currency to modern monetary currency and there are many culturally significant practices where this living currency cannot be substituted by monetary currency.

Of significance in the recognition of livestock as a living indigenous currency is the knowledge transfer around this cultural heritage and its multiple roles. This implies that the sustaining of the knowledge of livestock as a currency that serves multiple roles within indigenous community contexts occurs through transgenerational cultural education processes. Formal education processes should also play a significant role in dismantling the myth of a single monetary capitalist currency by valuing this living currency as a viable alternative to modern monetary currency, one that is not based on the logic of the capitalist monetary economy and which emphasises the coexistence of plural forms of currency.

Noting the coexistence of plural modes of economy and the current hegemony of modern capitalist monetary economies, it remains to be seen whether indigenous currencies will continue to be sustained. As environmental educators, on one hand, we question the stability and sustainability of monetary economies premised on unsustainable capitalist modes of production that are dependent on continued growth derived from finite Earth's ecosystem resources, which are rapidly being depleted and negatively impacted. On the other hand, we observe the implications of the uncurtailed growth of capitalist economies and related rapid urbanisation and environmental pollution and their concomitant negative impacts on environmental resources upon which indigenous peoples and their indigenous currencies are dependent.

Notes on the contributors

Lead author
Shava, Soul | Department of Environmental Education, University of South Africa (UNISA)
ORCID: 0000–0003-4103-0559 | shavas@unisa.ac.za
Soul Shava is an Associate Professor in Environmental Education, Department of Science and Technology Education at UNISA. His research interests are in education for sustainability, indigenous knowledges, decoloniality and Africanisation.

Co-author
Masuku, Sibongile | Sol Plaatje University, South Africa
ORCID: 0000–0003-4103-0559 | sibongiles.place@yahoo.com
Dr Sibongile Masuku is a lecturer of Museum and Heritage Studies at Sol Plaatje University. History, literature, education, cultural and natural heritage define her work, research interests and passion. Her PhD thesis is a postcolonial exploration of socio-cultural inter-generational learning through cattle as a medium of cultural expression in Mpembeni, KwaZulu-Natal.

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Challenges in tackling environmental concerns in indigenous education in Mexico

Rosa Guadalupe Mendoza-Zuany, Universidad Veracruzana, Mexico

Abstract

This article analyses the curriculum document called Indigenous language: Curriculum parameters, basic education, indigenous primary*, that outlines study programmes for indigenous languages in Mexico, specifically for the Indigenous Language Subject in primary schools prescribed by the General Department of Indigenous Education (DGEI) of the Public Education Secretary (SEP) in 2008. The curriculum document will be analysed for its inclusion of topics and concerns pertaining to the environment, nature, biodiversity and indigenous territories. This analysis is relevant because the Indigenous Language Subject is the only curriculum area that has been designed by indigenous teachers, as part of their struggle to see their languages and cultures placed on a level with Spanish. Two important issues stand out from the analysis. Firstly, the curriculum document recognises community elders and parents as bearers and builders of indigenous knowledge concerning the environment. Second, it recognises that children learn from everyday cultural practices such as farming crops, local food production, etc. However, the analysis also revealed matters of concern, and these should be treated as challenges to be overcome.*

Keywords: indigenous knowledge, indigenous education, environment, cultural practices, curriculum.

Resumen

En este artículo se analiza el documento "Lengua Indígena. Parámetros curriculares. Educación Básica. Primaria Indígena" – creado en 2008 – que propone programas de estudio para cada lengua indígena en México, específicamente para la Asignatura Lengua Indígena en escuelas primarias del subsistema indígena de la Dirección General de Educación Indígena (DGEI) de la Secretaría de Educación Pública (SEP) en México. Este documento curricular es analizado en torno a la inclusión de temas y preocupaciones sobre el medio ambiente, la naturaleza, la biodiversidad y los territorios indígenas. Este análisis es relevante, dado que la Asignatura Lengua Indígena ha constituido el único espacio curricular que han diseñado maestros indígenas en la lucha por el posicionamiento de sus lenguas y sus culturas a la par del español. Dos aspectos valiosos que sobresalen son el reconocimiento de los mayores y los padres de familia como portadores y constructores de conocimiento indígena sobre la naturaleza, así como el aprendizaje de los niños a partir de prácticas culturales cotidianas como el cultivo, la producción local de alimentos, etc. Sin embargo, también derivan preocupaciones que debemos visualizar como retos educativos.

Palabras clave: conocimiento indígena, educación indígena, medio ambiente, prácticas culturales, currículum.

Introduction

From a human rights perspective, basic education should be relevant for indigenous children in Mexico, both culturally and linguistically. There are 68 indigenous languages spoken in Mexico, with over 300 variants. Nevertheless, Agreement 592, which establishes the Implementation of Basic Education (2011) delineating the educational model in use up to 2017, and the proposed New Educational Model to be introduced gradually from 2018, both keep indigenous and culturally situational knowledge doubly on the margins of the national curriculum. It is only partially considered in the Indigenous Language Subject taught in indigenous pre-school and primary schools, which means that it is only taught to children who study within the indigenous sub-system schools, and not to indigenous or non-indigenous children who attend regular schools.

The indigenous knowledge in the subject includes the meanings attributed to nature and people's relationship to it, as well as meanings attributed to that which the indigenous peoples consider their territory; however, its coverage in the curriculum is restricted, marginal, insufficient and limited. The way the subject is constituted makes no recognition of the epistemological pluralism that is expressed in the distinctive ways indigenous people build knowledge in their own language, nor any recognition of indigenous peoples' ethical disposition towards their territory, which stands in contrast to the individual ownership and extractive model of modern neoliberalism. This problem is not exclusive to Mexico. With reference to South Africa, Shava and O'Donoghue (2014:4) note: 'Our school curricula have, to a large extent, been highly westernised, with little opportunity for including indigenous knowledges. Indigenous knowledges have been excluded, marginalised, misrepresented, invalidated and labelled as inferior.'

Within this context, this article will analyse the curriculum document called *Indigenous language: Curriculum parameters, basic education, indigenous primary* (DGEI, 2008) that outlines study programmes for indigenous languages, specifically for the Indigenous Language Subject prescribed by the General Department of Indigenous Education (DGEI) of the Public Education Secretary (SEP) in 2008 and in force until 2017, when the New Educational Model was published, and which did not mention specific study programmes for languages. The curriculum document will be analysed for its inclusion of topics and concerns pertaining to the environment, nature, biodiversity and indigenous territories from plural systems of knowledge (western and indigenous).

It is relevant to look at the inclusion of the perspective of indigenous peoples regarding these issues, a perspective that I regard as indigenous knowledge (IK) and which Grenier (1998:1) defines as

> unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area […] [IK systems] are cumulative, representing generations of experiences, careful observations, and trial-and-error experiments.

This analysis is relevant because the Indigenous Language Subject is the only curriculum area designed by indigenous teachers, as part of their struggle to see their languages and cultures

placed on a level with Spanish. One thing that stands out in this specific subject for providing education services to indigenous children is that the socio-environmental and territorial defence concerns of indigenous peoples have not been given sufficient, nor critical, space. The analysis will focus on some of the main features through which those who designed the curriculum document – indigenous education teachers and bureaucrats – tackled the environment, biodiversity and environmental problems.

Two important aspects that stand out are the recognition of community elders and parents as bearers and builders of indigenous knowledge concerning the environment, and the understanding that children learn from everyday cultural practices such as farming crops, local food production, etc. However, there are also concerns about the Indigenous Languages Subject that we should see as challenges, namely:

- The limited inclusion of topics concerning territory and the environment;
- The emphasis placed on the consequences rather than the causes of environmental problems;
- The limited range of textual products relating to these subjects;
- The lack of emphasis on the comparison of cultural perspectives; and
- The encyclopaedic nature of the texts to be produced by learners to preserve traditional knowledge in the indigenous discursive practices of daily life and in the curriculum.

Panorama of the Mexican context

To provide relevant education to the children and youth of indigenous peoples – as is their right – has been a complicated matter in Mexico as in the world at large. The way to understand key aspects of this matter as it manifests in Mexico is to examine the changing policies associated with the historically changing national project.

In the nineteenth and early twentieth centuries – periods of construction and reconstruction for the nation-state – cultural diversity was seen as an obstacle to national unity and the economic and social development of the country. In response, strongly homogenising cultural and linguistic processes were implemented. Schools took responsibility for hispanicising the population in a project that sought unity above everything else, failing to recognise the multicultural and linguistically diverse character of indigenous communities (Niembro Domínquez & Mendoza-Zuany, 2017).

Since the 1990s, this homogenising strategy has changed and interculturality and bilingualism have instead become two fundamental elements in education for indigenous peoples. The rights of indigenous people in the area of education and in national and international law-making – demanded by indigenous movements that gained strength in the nineties – provide a frame of reference for improvements that should guide government action and educational policy (Mendoza-Zuany, 2017b).

The indigenous education sub-system in Mexico serves children and young people in indigenous nursery schools, pre-schools and primary schools in rural locations. Its objective is to provide, by means of an educational model within the framework of diversity, an equitable

and educationally relevant focus that includes indigenous peoples' language and culture as necessary components of the curriculum. It is important to point out that indigenous education is based on the study plan and programmes followed by all Mexicans, both in the previous curriculum and in the New Educational Model. Its specificity arose through the offering of the Indigenous Language Subject in the curriculum framework. In 2011, the Basic Education Study Plan made the Indigenous Language Subject official in indigenous primary education, and it was added to the curriculum map aimed at indigenous education, making its teaching compulsory. In 2008, the DGEI stated, 'The Indigenous Language Subject should be complemented with the teaching of Spanish as a second language to thus cover the requirements of the Constitution to offer an inter-cultural and bilingual education' (DGEI, 2008:7). It was therefore necessary and unavoidable for the study programmes for these languages to be created so that indigenous children can have the opportunity to analyse, reflect on and study their mother tongue with the aim of widening its social use and using it consciously in their school learning and social life. The idea was for schools to contribute to indigenous learners' development of efficient oral and written communicative abilities in their indigenous languages and in Spanish as a second language.

Nevertheless, since 2008, important limitations have been observed regarding this subject. While there is a curriculum from which to develop study plans for this subject, programmes have only been designed for those languages that have a large number of speakers. In addition, text books for this subject have not been made available for learners. There is thus a serious lack of educational materials. An additional limitation is the fact that indigenous languages are only taught in pre-schools and primary schools. From secondary school onwards, education is provided exclusively in Spanish. The limited number of hours per week dedicated to this part of the curriculum is yet another failing.

It is also worth mentioning that indigenous children in Mexico do not only attend indigenous schools; some of them go to regular schools that do not teach the Indigenous Language Subject. This occurs mainly due to migration from the countryside to the city. The complexity of providing education for indigenous children is increased by difficulties in identifying them accurately. Learners can be considered indigenous by self-description and/ or because they speak an indigenous language. They may speak an indigenous language either as their mother tongue (L1) or as a second language (L2). Only 53.4% of primary pupils who speak an indigenous language go to an indigenous school, which means that 46.6% of indigenous children in primary school are far from finding a path to the cultural and linguistic belonging that indigenous education aims to achieve (INEE–UNICEF, 2016). Furthermore, 73.2% of the indigenous population and nine out of ten school-aged speakers of indigenous languages live in poverty, which affects their access to, and continuity in, school (INEE–UNICEF, 2016). Hence, the minimum requirements for social well-being are lacking, and this undoubtedly affects school performance.

The study programmes for each indigenous language have been promoted since 2008 against resistance, and their continuity is unsure under the recent New Educational Model, which makes no mention of specific study programmes in indigenous languages. In 2017, a New Educational Model and a Curriculum Proposal for Compulsory Education were proposed

(covering pre-school to high school). Although a specific space for indigenous education is still considered within the subject 'Mother tongue' (this includes 'Indigenous tongue' and 'Second language'), the subject area 'Language and communication' makes a single proposal for all indigenous languages, disregarding the fact that each indigenous group has their own distinct culture, language and way of seeing and recreating life. Therefore, the learning of language and culture according to each group's frames of reference is not tackled in specific programmes for each language.

With the New Model, we still have limited curriculum space, since the eight hours set aside for Mother-tongue will be divided up to give five hours to Mother-tongue and three hours to Second language (the classification of Mother-tongue versus Second language varies from school to school depending on a socio-linguistic diagnostic that specifies the language for an area).

One important and positive innovation in the New Educational Model is that the Indigenous Language Subject can be taught as L1 or L2, depending on each school's socio-linguistic diagnostic. These changes in the model are part of a tendency in educational policy for indigenous peoples that has moved from an intercultural focus to an inclusive one. This has important implications (Mendoza-Zuany, 2017a), among which we can identify the tendency towards the construction of an educational system without an indigenous sub-system, under the premise that indigenous peoples are vulnerable groups who should be served in the same, inclusive school with a single classroom for all.

In this article, our analysis will focus on the curriculum document which, from 2008 to 2017, allowed for the design of study programmes for each language. It was under the coordination of the Department for the Strengthening and Development of Indigenous Languages (Dirección de Fortalecimiento y Desarrollo de las Lenguas Indígenas) of the DGEI that, since 2008, study programmes and teacher books have been created for some indigenous languages, containing instructional projects to specifically tackle the languages' social practices and the instructional orientation for their implementation. As has been mentioned, the designing committees that created the study programmes were made up of teachers who speak the languages in question. These committees receive continuous training and support to carry out this curriculum work. The teachers, principals, supervisors and technical assessors who work with the languages that have study programmes periodically receive training and support for the teaching of Spanish as a second language and have access to educational projects that allow them to foster the development of bilingualism among indigenous children.

Those teachers who work with languages that have no study programmes, however, create their own instructional strategies based on the general document, *Indigenous language: Curriculum parameters, basic education, indigenous primary* (DGEI, 2008). This document will be analysed here.

It is important to stress that the significance of analysing the curriculum document supporting the Indigenous Language Subject lies in the fact that this document lays the foundations for the curriculum design. This is now the only space available for the inclusion of indigenous knowledge in a homogenising national curriculum, one that – through exclusion and sometimes through folklorisation – does not recognise the epistemic plurality of indigenous knowledge.

Indigenous peoples and their territories

Educational policy cannot ignore the ancient relationship between indigenous peoples and their ecological surroundings and the knowledge built from extracting their territories' resources as a means of survival. In terms of cultural and biological diversity alone, Toledo and Barrera-Bassols demonstrate the connections between linguistic, biological, genetic, cognitive, agricultural and scenic diversity that make up a 'biological–cultural' complex (2009:25) that is the result of thousands of years of interaction between traditional societies and their ecosystems. International treaties also recognise the close links between indigenous populations and their biological environment. For example, the Convention on Biological Diversity, ratified by Mexico, mentions the agreement to 'respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity' (Article 8(j)).

Toledo and Barrera-Bassols (2009) calculate the indigenous population of the world at over 330 million people living in 75 of the world's 184 nations, including groups in each of the planet's main ecosystems, especially those terrestrial and aquatic ecosystems least touched by humankind (Burger, 1987). An example of the overlap between indigenous peoples and highly biodiverse areas is that which occurs in tropical rainforests: 'there is a clear correspondence between areas of remaining tropical forests and the presence of indigenous peoples in Latin America, the Congo Basin in Africa, and several countries of tropical Asia' (Toledo & Barrera-Bassols, 2009:53).

The richness of landscapes and knowledge that have been generated in these overlaps between biological and cultural diversity is not restricted to the way in which ecosystems in indigenous territories have been preserved. It also covers the processes of domestication and production of new ecologically and commercially important species that have been developed through centuries of experimentation and detailed observation of the ecological processes in the environments where they have historically occurred. Most of the crops that feed the world have passed through domestication processes carried out by indigenous peoples. These species, products and sub-products have evolved through a long process of selection, diversification, innovation, exchange with other regions, adaptation and genetic improvement (Boege, 2008) over many generations. This reveals that there is not only cultural or biological richness, but also a richness of practices and knowledge that have been developed to meet the basic needs of human populations.

Despite the fact that most of the world's biological wealth is under the guardianship of indigenous peoples, the advent of modernity has subjected these peoples to a range of pressures that compromise the socio-ecological processes they depend on. Mining is one example. The insufficiently regulated extraction of minerals from indigenous territories provokes severe environmental damage (Alimonda, 2011). The effects of climate change on indigenous peoples is another important pressure to consider in how it relates to educational policies for indigenous communities (Salick & Byg, 2007). These negative effects include decreasing access to water and changes in the traditional cycles of planting and harvesting – both of which compromise indigenous peoples' capacity to produce food for survival.

Nature, environment and territory in indigenous languages' study programmes

The curriculum document – *Indigenous language curriculum parameters: Basic education, indigenous primary* – was written by 30 bilingual indigenous teachers of various languages, with input from expert academics. It arose from 'the idea that the study of language at school should promote reflection concerning the language itself and its uses, including the language of school life' (DGEI, 2008:11). It proposes that study programmes should be rooted in language practices that are related to the following four areas, with specific content recommended for each area:

1. Family and community life;
2. Oral tradition, literature and historical testimony;
3. Inter-community life and relationships with other peoples; and
4. The study and dissemination of knowledge. *(DGEI, 2008:16)*

The programmes are arranged in cycles: a first cycle covering first and second grade in primary school (6–8 years old); a second cycle that covers third and fourth grade (9–10 years old); and a third cycle covering children aged 11 to 12.

The two valuable aspects of the curriculum document discussed next relate to living people as bearers of knowledge transmitted through everyday cultural practices.

Older people and parents as transmitters of knowledge

The curriculum document refers to the elders, the knowers and parents as bearers of knowledge, and as validators of this information that children are encouraged to write down. Similarly, the knowledge children gain within the family is emphasised, for example through the teachings of their parents regarding agricultural activities and other means of production, such as tending cattle, fishing, weaving, etc. A specific example could be that of a recipe book composed with the collaboration of the children's mothers and their knowledge of traditional units of measurement.

The inclusion of older people and parents as transmitters of knowledge helps to counter the fact that school curricula have 'excluded the role of parents and elderly people in the education of their children about their culture, values and livelihoods' (Shava & O'Donoghue, 2014:4). According to Grenier (1998:5):

> more and more knowledge is being lost as a result of the disruption of traditional channels of oral communication […] because IK is transmitted orally, it is vulnerable to rapid change – especially when people are displaced or when young people acquire values and lifestyles different from those of their ancestors.

Knowledge from personal experience

Indigenous knowledge comes from participating in group work in families and communities, and is created through the children's own experiences. The document suggests projects that will encourage children to reflect on their knowledge-producing experiences:

> The knowledge of local production is not restricted to specific information, but considers experiences, the use of instruments, values, ways of relating to nature, the practice of rituals or ceremonies, discourses, and many other aspects. Reflecting on these experiences, and their participation in agricultural work or other trades passed on by their parents (handicrafts, for example) helps them understand their participation in group work, and the importance of these practices for their family and community life. *(DGEI, 2008:132)*

This approach counters the exclusion that Shava and O'Donoghue have also observed in the South African context: 'Education institutions (such as schools) in particular have been zones of exclusion of such knowledge. This has created a situation where what the learners learn at school is different form their lived experiences at home' (2014:4).

Concerns and challenges

Having pointed out two positive aspects, the analysis of the curriculum document also reveals certain challenges.

Insufficiency of topics relating to territory and the environment

The insufficient incorporation of topics relating to territory and environment (such as care for the environment, plants, etc.) becomes apparent when it is observed that practically the only area in which these issues arise is that associated with 'Study and diffusion of knowledge'. The ritual language of ceremonies commemorating mother nature is marginally tackled in the area 'Family and community life'. Projects relating to nature are not mentioned at all in the subject area 'Oral tradition, literature and historical testimony', nor in 'Inter-community life and relationships with other peoples', except for sporadic instructions to record oral and written narrations of real events 'concerning natural phenomena' and experiences of nature. For example, out of 24 projects suggested for the first cycle, only three refer to any topic related to the environment; in the second cycle, only six out of 34 projects refer to such topics; and, in the third cycle, only three out of 35 projects make any such references (DGEI, 2008).

The potential that the traditional management of territory and landscape clearly presents is not taken advantage of as a context for generating learning and critical reflection on the problems and challenges directly affecting indigenous communities (Brandt, 2013).

Emphasis on the consequences of environmental problems, not their causes

We notice an emphasis on the consequences rather than the causes of environmental problems; community, inter-community and extra-community tensions caused by the management of their territories and natural resources are also left out of the picture. For instance, in suggesting that students record and narrate current events 'relating to natural phenomena', emphasis is placed on recording a 'testimony of consequences or effects on community life' (DGEI, 2008:38). Whilst we point out the obvious limitation of referring to natural phenomena as the only current events to be recorded, it is also worth noting that there is no instruction to

investigate the causes of current events and socio-environmental problems (e.g. climate change, fracking, open-cast mining).

In 'Study and the dissemination of knowledge' in the second cycle, there is a suggested project to investigate measures for preventing the consumption of foods containing toxic substances; nevertheless, the socio-environmental aspect of the problem is not addressed and there is no suggestion to investigate why herbicides are used, which interested parties promote their use, and what the relationship is between their use and the (unhealthy) condition of water sources. In the same vein, in the proposed project to organise a campaign to popularise environmental protection behaviours in order to prevent pollution (of the water, earth or air), it is only suggested that pupils investigate conservation activities, without any emphasis on investigating the community and extra-community consumption and the damaging behaviours (material practices) that cause these different types of pollution. Activities are promoted that respond to external interests and concerns rather than to local concerns about the environment.

Further, there is no promotion of research projects that could involve children as active researchers (Barrat Hacking et al., 2013) of their own realities, or that could help them to develop a critical view of the issues affecting them and how these issues could be resolved.

Finally, there is no recognition that bearers of traditional knowledge systems look at problems holistically, with all their complexities and multiple connections (Grenier, 1998).

Lack of variety of texts relating to territory and the environment

In these proposed projects, there is little variety in the materials relating to environmental topics – these being limited to lists of plants and their properties, catalogues, lists of herbal medicines and posters. In the first cycle, for instance, a project is proposed to draw up lists of crops and plants; in the second cycle, to produce catalogues and lists of herbal medicines; and in the third cycle, catalogues are again suggested along with descriptions of medicinal plants and their uses. Only one project suggests the production of a book of questions and answers, recommendations and advice concerning crops.

The lack of analytical texts that could introduce reflection and analysis is a significant gap in the subject. While the subject is fundamentally directed towards language teaching, it could still incorporate experiential learning and learning-by-doing experiences (Shava & O'Donoghue, 2014) that would lead to active participation in events and to demonstrations of cultural practices in or outside the classroom, amongst other activities. The emphasis on specific textual products directed towards developing linguistic ability ignores the potential for developing such analytical skills as suggested by Shava and O'Donoghue (2014:33):

> appreciating the enormous variety of life and life systems in the local (and global) context(s) […] the conceptualisation of how different living organisms are interrelated in nature and the natural processes within ecosystems; […] understanding the impacts of human activities on ecosystems, their interrelated nature and the implications to human well-being; and appreciating the role of indigenous science in the development of the range of responses to ecosystem loss.

Little emphasis on the comparison of cultural perspectives

Although the production of texts with a cultural perspective regarding environmental care is alluded to, there is no actual suggestion to contrast this perspective – or enter into dialogue – with different perspectives covered in other subjects in the national curriculum that relate to the environment.

One important source of contrasting perspectives is covered in the subjects 'Knowledge about the environment' (first and second grade), 'Natural sciences and technology' and 'Geography' (third to sixth grade), and 'Stories, landscape and coexistence in my area' (third grade). Reference is made, for example, to the interpretation of natural phenomena to forecast the weather, but without insisting on the importance of such examples in demonstrating the production of valid knowledge that is not tied to the hegemonic scientific method. This is not just about recording alternative meanings for natural phenomena, but rather about creating a dialogue between these meanings and the hegemonic meanings, and about valuing present-day indigenous ways of creating knowledge that could be used as strategies directed towards the development of critical thinking among indigenous learners, as exemplified in Maurial's proposal, Indigenous Dialogical Education (1999). The underlying idea in the curriculum document and the educational practices is that interpretation from their own cultural perspective is traditional, and the traditional is not current, which becomes apparent when students talk about natural phenomena and their consequences, comparing their traditional worldview with a present-day perspective (DGEI, 2008:135).

Encyclopaedic nature of the texts for preserving traditional knowledge

We can also point out the 'encyclopaedic nature' of the texts to be produced, for example, when suggesting a record of plants 'facing extinction' (DGEI, 2008:90) in a list of herbal medicines. The rationale is that this knowledge is being lost (DGEI, 2008:50) and therefore we need to record, organise, promote and preserve it. To justify this, the value of writing as a way of preserving knowledge is invoked. This is important, but this approach might produce a static version of the collected knowledge, without considering current and dynamic cultural practices.

In each cycle, older traditions are introduced into projects in 'Oral tradition, literature and historical testimony', for example promoting the recording of traditional stories that include references to animals, plants, sacred places, and the origin of the world and the human race. No advantage is taken of the fact that the community can also be a classroom (Semali, 1999) in which students can connect the proposals of the curriculum with the knowledge of the community. The 'encyclopaedic' knowledge becomes disconnected from practices occurring in the framework of a belief system which has been transmitted from generation to generation (George, 1999). Thus

> the main hurdle to be overcome is the fact that indigenous knowledge is not normally 'packaged' as school materials are. The school teacher must, therefore, first access the indigenous knowledge, then understand it and its likely relation to what is to be taught in the class. Furthermore, s(he) must devise teaching strategies for using it effectively. *(George, 1999:84)*

Conclusions

The fact that the Indigenous Language Subject is intended to develop linguistic abilities does not preclude the possibility of its deliberately strengthening some aspects of environmental education related to indigenous contexts.

Finding ourselves in a chrono-pedagogical stage in which we understand the environmental crisis, we recognise the human and ecological factors that cause it. The challenge of the transformation necessary to build an environmentally sustainable and socially fair society makes education a political – not just pedagogical – act that directs us towards values and attitudes for such a transformation (Caride & Meira, 2001). In particular, education for indigenous peoples, through the only specific curriculum space – the Indigenous Language Subject – should be taken up as a political act that promotes analysis and reflection concerning the environment and indigenous peoples' territories in a global context. The subject should be seen as a curriculum space that goes beyond the development of linguistic ability to develop analytical skills as well. As such, it requires a greater variety of learning products.

This subject should also give the child a sense of their place in the world – both globally and locally – and favour the recognition of cultural diversity as well as the capacity of each indigenous group for building specific sustainable projects in dialogue with others. Doing so will require going beyond the encyclopaedic approach of tackling the environment and biodiversity in order to place these issues in a specific place and time, recognising their dynamism and changeability.

About the contributor

Mendoza-Zuany, Rosa Guadalupe | Universidad Veracruzana, Mexico
ORCID 0000-0002-5503-4158 | lupitamendoza.zuany@gmail.com
Rosa gained her PhD in Politics from the University of York (United Kingdom). Her research interests are educational policies in culturally diverse contexts and a critical revision of inclusion as a replacement for interculturality.

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Pursuing epistemological plurality in South Africa's Eco-Schools: Discursive rules for knowledge legitimation

Lisa Ryan and Jo-Anne Ferreira, Southern Cross University, Australia

Abstract

Efforts to re-appropriate indigenous knowledges reveal a discursive friction experienced by Eco-School support workers in South Africa as they attempt to build an epistemologically pluralistic curriculum. This paper outlines the strategies that South African Eco-School support workers and teachers employ in negotiating this friction and highlights the discursive rules that govern what constitutes legitimate knowledge in the South African Eco-School. The unintended consequences of these strategies that may affect the representation of indigenous peoples is also discussed.

Key words: Eco-School, discourse analysis, indigenous knowledge, postcolonial theory.

Introduction

The Foundation for Environmental Education's Green Flag Eco-School Programme, originally designed in Europe, is the largest and most well-recognised environmental education programme in the world. Acknowledged by the United Nations Environment Programme (UNEP) as a model initiative for Education for Sustainability, it has been adopted in over 67 countries (Eco-Schools, 2014). Because of its wide reach into a variety of different cultural contexts, it is important to consider the ways in which a global programme such as Eco-Schools – underpinned as it is by a variety of western discourses – may work to standardise or 'colonise' environmental education internationally. However, such effects have not been well researched.

Drawing on a case study of the implementation of Eco-Schools in South Africa by the host organisation – the Wildlife and Environment Society of South Africa (WESSA) – we examine the ways in which the Eco-School programme legitimates and defines what counts as environmental education knowledge in South African Eco-Schools. Through an examination of the ways that Eco-School teachers negotiate different knowledges and knowledge systems in the course of their work, we explore how conflicting global and local discourses are contested, negotiated and worked through in the South African Eco-School. This is achieved through an analysis of 22 different Eco-School curriculum resources from the Foundation for Environmental Education (FEE) and WESSA, as well as interviews with 20 South African Eco-School support workers and teachers. We argue that there is a hybridisation of Eco-schooling knowledge and practices in South Africa, particularly in relation to the ways that scientific and indigenous knowledges are negotiated, and that this has implications for the way indigenous peoples and their knowledges are represented within and through the programme.

Background: Eco-Schools in South Africa

The FEE Green Flag Eco-Schools Programme was originally launched by the Foundation for Environmental Education in Europe in 1994, as a direct response to the Sustainable Development Agenda championed at the Rio Earth Summit. The programme has expanded globally and is now the largest and fastest growing school-based environmental education programme internationally. As of 2017, over 51 000 schools across 67 countries and over 19 million learners participated in Eco-Schools (Eco-Schools, n.d.).

A focus on the participation of students in actively managing the environmental and sustainability impacts of the school and in working towards positive environmental change is central to the Eco-Schools programme. This commitment to environmental management is evident in the Eco-Schools methodology, encompassing seven steps that schools should adopt:

Step 1: Establishment of the Eco-Schools Committee with broad participation across school stakeholders to guide the programme.

Step 2: Environmental Review to provide baseline data on environmental and sustainability impacts.

Step 3: Action Plan developed in collaboration with learners and teachers to target key parameters.

Step 4: Monitoring and Evaluation of targeted parameters.

Step 5: Linking the programme to the school curriculum.

Step 6: Informing and Involving the wider community.

Step 7: Development of an Eco-Code to ensure sustainability ethics are embedded in school culture. *(Eco-Schools, 2014)*

Eco-Schools able to demonstrate sufficient progress across a number of sustainability parameters such as water and energy use, waste, biodiversity, habitat, health and transport are awarded an International Green Flag. The Green Flag has become internationally recognised as an indication of environmental excellence and is thus a desirable status symbol (UNEP-FEE, 2003).

In 2003, under the auspices of WESSA, South Africa became the first country outside of Europe to adopt Eco-Schools, making the South African programme the longest running example of the programme outside Europe. The Green Flag award is a highly prized commodity in South African schools. Unlike many European countries who judge their Green Flag award on schools meeting a particular minimum standard, in South Africa the award is judged on each school submitting a portfolio that demonstrates the school's progression towards whole-school

sustainability projects. A key difference then between the global Eco-Schools programme and South Africa's version is that schools are rewarded, not for meeting a particular standard, but for their *progress towards* particular sustainability goals.

As the national operator, WESSA is responsible for implementing the programme in South Africa within FEE's guidelines (FEE, 2012). Under these guidelines, WESSA pays an annual membership levy and must ensure that that the quality, integrity and international standing of the programme are maintained.

To assist schools in progressing towards sustainability, WESSA provides South African Eco-Schools with guidelines, a handbook, and a range of curriculum resources that explicitly link Eco-Schools themes to the South African national curriculum. In-school support for Eco-School projects is also provided through a network of node coordinators (Eco-School support workers) in each province. The role of WESSA Eco-School support workers is significant. They act as 'experts' and knowledge brokers of environmental education, interpreting and adapting the global programme to suit the South African context. Together with the curricular guidelines, Eco-School support workers – as 'experts' – exercise considerable power in the shaping and framing of what counts as legitimate Eco-schooling knowledges and practices in South Africa.

Global and local Eco-schooling discourses: Negotiating discursive contestation

Eco-schooling can be thought of as a 'discursive field' (Weedon, 1987:35) in that it contains a number of different and sometimes competing global and local discourses, with varying degrees of power that have shaped the systems of meaning and what counts as legitimate, 'true' knowledge within the Eco-School.

We know that many global discourses are privileged as 'universal' truths. These 'regimes of truth' (Foucault, 1980) are also at work defining what counts as valid knowledge in the Eco-School and thus have considerable effects in shaping Eco-schooling policies, practices and procedures everywhere FEE Eco-Schools operate. For example, in the Eco-School, the global sustainability discourse of ecological modernisation (Huckle, 2009; Ryan, 2017) is privileged. Ecological modernisation (Dryzek, 2013; Mol & Sonnenfeld, 2000; Redclift, 1994) refers to a greening of contemporary neoliberal capitalism. It is generally conceived of as a reformist rather than radical discourse where environmental problems are considered as 'accidents on the way to progress', to be solved by whatever technical means are at our disposal (Colombo & Porcu, 2014) As such, ecological modernisation privileges scientific knowledge systems.

This scientific focus is clearly evident in Eco-Schools' concern for the monitoring and management of environmental problems, which are fundamental processes underpinning the programme. Strategies employed by Eco-Schools such as monitoring of resource and waste flows through environmental management systems and the adoption of technological 'fixes' to environmental problems are examples of mechanisms favoured by ecological modernisation (Howes, McKenzie, Gleeson, Gray, Byrne & Daniels, 2010; Mol & Sonnenfeld, 2000). South African Eco-Schools are clearly influenced by this powerful global Eco-School – and environmental – discourse. There are many examples of South African Eco-Schools

undertaking ecologically modernist projects such as monitoring and reducing energy and water use through energy efficiency technologies such as geezer blankets and wastewater recycling systems (Ryan, 2017).

While analysis of the Eco-Schools programme shows that it is subject to global discourses such as the scientific discourse of ecological modernisation, at the same time, it is also strongly underpinned by local justice discourses that promote the inclusion and re-appropriation of indigenous knowledges. Re-appropriation refers to the uncovering and recovery of previously lost and subjugated knowledges for meaning-making in contemporary societies (Masuku van Damme & Neluvhalani, 2004) (as opposed to appropriation (Giddens, 1991), which refers to the politics of knowledge creation, encompassing processes of oversight, transformation, marginalisation and subjugation). Yet within Eco-Schools, the re-appropriation of indigenous knowledge, itself a contested process (Kanu, 2011), does not always sit comfortably with the broader global ecological modernisation discourse that is highly technical and prioritises scientific knowledge.

Re-appropriating indigenous knowledges then presents a significant site of discursive contestation since it requires teachers to hold a number of divergent epistemological positions, including global scientific and local indigenous knowledges. These require Eco-School teachers to experience the limits of each discourse and actively negotiate their boundaries. In doing so, they encounter areas of compatibility, friction and impasse. How teachers manage this provides a particularly telling example of the ways in which global and local discourses are worked through and in which particular rules are laid down to validate particular versions of Eco-schooling knowledge.

When discourses are negotiated and the rules and 'knowledge hierarchies' (Dei, Hall & Rosenberg, 2000) for each discourse are made clearer, the kinds of indigenous knowledges that can be used, in what contexts and by whom, also become clearer. Such rules can be interpolated from an examination of indigenous knowledge curriculum resources and from discussions with Eco-School workers and teachers about how they negotiate the relationships between indigenous and scientific knowledges in Eco-Schools.

Research methods

Data for this research were gathered from 16 semi-structured interviews and two focus groups, encompassing five Eco-School teachers and 15 Eco-School support workers. Participants were selected through snow-ball sampling (Valentine, 1997), where we were introduced to Eco-School teachers and support workers across six of South Africa's nine provinces (Eastern Cape, Gauteng, KwaZulu-Natal, Limpopo, North West and Western Cape) by Eco-School national and provincial coordinators as well as by participating teachers. Collectively, participants were drawn from a range of South Africa's schooling types including relatively well-funded urban and rural schools, low-income rural farm schools and low-income urban township schools. They also encompassed a variety of ethnic backgrounds. Table 1 provides basic demographic data on participants. In order to protect identities, demographic data were not broken down further into provincial or ethnic categories.

Table 1. Key demographic categories of research participants

EST 1	Eco-School principal (former Model C rural school), White, male
EST 2	Eco-School teacher (low-income school, rural area), Black, male
EST 3	Eco-School teacher (low-income school, urban informal settlement), Black, female
EST 4	Eco-School teacher (low-income school, rural area), Black, male
EST 5	Eco-School teacher (low-income school, rural area), White, female
ESW 1	Eco-School support worker (node coordinator, rural area), Black, male
ESW 2	Eco-School support worker (node coordinator, urban township), White, female
ESW 3	Eco-School support worker (provincial coordinator), White, female
ESW 4	Eco-School support worker (node coordinator, urban/rural area), White, female
ESW 5	Eco-School support worker (provincial coordinator), Black, female
ESW 6	Eco-School support worker (node coordinator, rural area), Black, male
ESW 7	Eco-School support worker (provincial coordinator, urban/rural area), White, female
ESW 8	Eco-School support worker (node coordinator, urban/rural area), White, female
ESW 9	Eco-School support worker (provincial coordinator, urban/rural area), White, female
ESW 10	Eco-School support worker (node coordinator, urban/rural area), White, female
ESW 11	Eco-School support worker (provincial coordinator, urban/rural area), Black, female
ESW 12	Eco-School support worker (node coordinator, urban/rural area), White, female
ESW 13	Eco-School support worker (node coordinator, rural area), White, female
ESW 14	Eco-School support worker (provincial coordinator, urban/rural area), Black, female
ESW 15	Eco-School support worker (node coordinator, urban area), White, female

Semi-structured interview questions were designed with the aim of capturing the complexities of participants' experiences as South African Eco-School teachers and support workers. We hoped to encourage the sharing of stories in which participants' identities as Eco-School teachers and workers would be foregrounded. Our interview schedule was thus designed around a number of broad categories:

1. Research participants' autobiographical narratives as Eco-School teachers.
2. Professional opinions and thoughts about the global Eco-School programme.
3. Stories of challenge and tension in the Eco-School in South Africa.

A postcolonial lens was employed in analysis of the data to illuminate the everyday effects of power on teachers' perceptions of themselves and their work. Postcolonial concepts offer an innovative way of investigating teacher identity and self-perceptions of capacity and

agency in environmental education because they emphasise the powerful colonising effects of discourse as well as the possibility of agency through discursive disruption. In particular, we focused on perceptions about the global and contextual forces that framed participants as Eco-School teachers and shaped their practice. We also wanted to elicit stories of resistance against such framing. Thus, our aim was to capture the 'third space' (Bhabha, 1994) or 'borderland culture' (Anzaldúa, 1987) that we hypothesised participants inhabit as South African Eco-School teachers.

Mobilising indigenous knowledge in the South African Eco-School: Rules of discourse

Since the 1980s, indigenous knowledges have gained increased attention in the field of environmental education (Ellen, 2002; Nygren, 1999; Shava, 2013). There has also been a range of United Nations and intergovernmental agreements advocating for the value of indigenous knowledges, such as the *Declaration on the Rights of Indigenous Peoples* (United Nations, 2007). These developments signal a major shift in power/knowledge relations between western scientific institutions and indigenous communities (Shava, 2013). As a result of a growing justice discourse, the value of indigenous communities and their knowledges is increasingly recognised. This is particularly so given that western science seems unable to answer many of the complex 'wicked' (Rittel & Webber, 1973) problems of the contemporary world. Indigenous knowledges are now also seen as valuable sources of epistemological diversity (Lotz-Sisikta, 2002; Shava, 2013).

Many African writers have worked to define and articulate what is meant by indigenous knowledges in a Southern African context (e.g. Kumalo, 2017; Le Grange, 2012; Ramose, 2014; Odora Hoppers, 2002; Shava, 2013; Masuku van Damme & Neluvhalani, 2004). Such writers present these not as isolated knowledges and beliefs, but rather as an integrated worldview consistent with a clear ethic for sustainable living. Le Grange (2012) for example points to the concepts of *ubuntu* (interdependence) and *ukama* (relationality) as key ethical paradigms underpinning African knowledge systems. *Ubuntu* is often defined as a concept that recognises the humanity in the 'Other' (with all their uniqueness and difference) – being a quality we owe to each other (Eze, 2010). This moral obligation, Le Grange (2012:143) argues, should not only be 'limited to human life, but extended to the natural environment'. Similarly, Ramose describes an African worldview as acting to 'promote life and avoid killing' (2014:68), elaborating that such a worldview extends an ethical position encompassing the living (including humans, plants and animals) and the 'living-dead or ancestors who continue to live with us, and leaving the land as good as we found it' (2014:75). These positions highlight the fundamental concern for the environment and sustainability in South African indigenous epistemes.

The increased willingness globally to engage with and re-appropriate indigenous knowledges is evident in South Africa, where it is clear that a re-affirmation of the value of indigenous knowledge is an important step in rebuilding pride and national identity (Lotz-Sisitka, 2006). The Indigenous Knowledges Systems Policy (2004), for example, demonstrates the commitment of the South African government to recognise, promote and develop indigenous

knowledge systems (IKS) throughout a range of policy mechanisms including integration of IKS into the national curriculum. In the South African Eco-School, the value of indigenous knowledge has also been recognised through the inclusion of community and heritage as a core curriculum theme. However, despite governmental and organisational support, the mobilisation of IKS in both schools and Eco-Schools has been problematic. Our research adds to the contributions of others (Kumalo, 2017; Le Grange, 2012; Masuku van Damme & Neluvhalani, 2004; Odora Hoppers, 2002; Ramose, 2014; Shava, 2008, 2013) in exploring the complex issue of re-appropriating IKS in the South African environmental education context.

Our research with Eco-School support staff and teachers, reveals an emerging tension of trying to build an epistemologically pluralistic curriculum where different knowledges can fit together into a workable framework. In their efforts to incorporate indigenous knowledge into the curriculum, Eco-School support workers are constantly negotiating the authenticity and epistemological commensurability of various knowledge systems. All the support workers interviewed mentioned the dilemmas faced when encountering ecologically destructive behaviours underpinned by traditional beliefs (such as the killing of frogs because they cause thunderstorms). A key challenge for them is how to raise the topic without causing offence. For example, in an interview with one of the Eco-School support workers, some of the challenges faced in negotiating these knowledge systems was raised:

> I think it's very difficult and I think the way one does it is to be very careful because the last thing you want is for someone to get even more adamant that what they believe is correct. I think there is certain information that is completely incorrect, and that, one needs to just present, but I think it's the way that you do it. That's really important. It's not saying that you're absolutely wrong. *(Eco-School Support Worker 7, 2012)*

While denying the legitimacy of traditional beliefs behind environmentally destructive behaviours, some support workers were willing to concede there may be valuable lessons underlying the origin of such beliefs, which could perhaps be classified as knowledge. For example, one support worker said she tries to think about why certain beliefs arose:

> Frogs shoot lightning from their eyes ... And then when you learn about what lightning is and how it's actually formed, it seems a little bit impossible that this could happen and maybe it is something that comes about because generally after a big thunderstorm first thing in spring, lots of frogs appear, and so there might be this link between thunderstorms and frogs, somehow, but it was something they'd gotten mixed up. Maybe we could challenge these ideas? *(Eco-School Support Worker 3, 2012)*

This support worker uses this example as a way of showing how the observations of previous generations, of frogs being seen in or after thunderstorms, could feasibly have led to the 'misconception' that frogs cause thunderstorms. She indicates that this example opens an opportunity to build on the observations made while also challenging the belief and in turn countering the negative environmental behaviours (such as killing frogs) that stem from the

belief. Such an approach, while discounting the belief, does not discount the observation that more frogs are seen after thunderstorms.

Another support worker explains how such beliefs may have arisen from attempts to preserve and protect ecologically sensitive and important areas such as water sources:

> I think there are beliefs that were in place to protect nature. To protect water from being polluted. To say to kids, there's a huge big snake waiting to eat you behind the lake. But let's think about why. Why your elders and your great, great, great, great, grandparents might have thought that it's important to have that myth? It's not just in Africa. There's Greek legends. There's Australian legends. There was a place for those things. *(Eco-Schools Support Worker 3, 2012)*

These approaches do not directly challenge the accuracy of the knowledge and importantly do not position scientific and indigenous knowledges as oppositional categories. Many Eco–School support workers went to great lengths to avoid directly opposing traditional beliefs in confrontational ways and adopted a range of different strategies to negotiate this area, leaving open the opportunity for epistemological plurality. For example, one support worker points to European examples of superstition as a way of demonstrating culturally parallel tendencies and an openness to self-critique:

> … you bring some of your own colonial or European superstitions into the conversations and indicate how little substance they have. Like a black cat crossing your path or waking under a ladder … and being able to laugh together about our shared idiosyncrasies and looking at examples of indigenous knowledge that are useful and practical and caring and bolstering those, so you're not brushing everything aside because of your viewpoints. *(Eco-Schools Support Worker 3, 2012)*

Another support worker's strategy is to appeal to reason, be it scientific or traditional. However, he also suggests alternative, sustainable behaviours that could be adopted instead:

> We tried many ways to find a good way to approach people about these things. When we say 'Don't kill these things', it's not like we say, 'Don't do this, don't do it … NEVER!'. No, we give them reasons why we say so. We say, 'Please don't cut down the whole tree, better you just cut some branches.' We say, 'Do it – but in a good way.' Like the old people, the San people, they used to hunt, but they only stayed in this place maybe for a month then they'd move to the other one so that the place can regrow. *(Eco-Schools Support Worker 1, 2012)*

Another support worker appeals to the logic of another dominant discourse within the community – religion. She deliberately frames problems or issues in religious terms, seeing religion as a more influential discursive logic than either scientific or indigenous knowledges:

> I also try and play on the religious aspect of it and in all religions, environment actually is quite important ... the teachers in South Africa are actually very, very Christian. So I play on that. 'Are

you saying God didn't know what he was doing when he made a snake or an owl?' Of course he did. There is a place for it. So it's my little cheat. *(Eco-Schools Support Worker 9, 2012)*

Other support workers found the issue of indigenous knowledge to be such a challenge that, if at all possible, they avoided having to address it. One support worker was quite self-reflective about the epistemological consequences and ethics of her negotiating strategies:

It's a tough one. As much as you don't want, it's a horrible thing to see owls being killed – Why do you deconstruct that? Why do you deconstruct that myth? What gives you the right to do that? How have I dealt with it? ... Myths are a tough one. I suppose just laying down the facts and for them to make the decisions, is all that I can do. And perhaps stating the order of things. If the owls go, what do you have instead? Is there anything alternative to the owls? But I tread very lightly there. If I don't have to get into the discussion, I won't. *(Eco-Schools Support Worker 11, 2012)*

In their efforts to implement an Eco-Schools programme in South Africa that hybridises indigenous knowledges with scientific knowledges, Eco-School support workers face a difficult task. Not all indigenous knowledges can be conceived of as environmentally friendly or benign and many unsustainable traditional practices are based on deeply rooted beliefs. Practices such as the widespread killing of owls, snakes and frogs (among other species) and the harvesting of animal parts for the *muthi* (traditional medicine) industry are all derived ostensibly from traditional indigenous knowledges.

Addressing unsustainable practices in indigenous knowledge systems is not simply a matter of correcting misinformation. Indigenous knowledges, including the examples cited above, are not just subjective ideas that have been dreamed up; they often have some basis in objective observation and empirical evidence. Vultures do possess acute vision and do have an uncanny ability to find prey; frogs do often come out in storms. Therefore, addressing epistemic unsustainability often requires extensive negotiation at the discursive level.

As outlined above, many of the Eco-School support workers interviewed demonstrated how they were engaged in this epistemological negotiation. None of them advocated strategies that directly confronted indigenous knowledges and behaviours, for fear of provoking negative reactions. They were far subtler in their tactics: some adopted discourses of alternative knowledge systems such as science or religion to provide alternative influential perspectives; some provoked a critical reflection on the knowledge by asking consequential questions; and some demonstrated parallel superstitions from European culture. A couple were also willing to acknowledge that there may be truth in the underlying metaphors behind these beliefs, which either might be classified as knowledge or lead to misconceptions.

In the face of the apparent incommensurability of knowledge systems, Eco-School support workers are essentially forced to make rules about what does and does not count as indigenous knowledge in the Eco-School. There did not seem to be a great deal of self-reflection, however, on the ethics of the rules of the discourse, with only one interviewee indicating that she wondered what right she had to 'deconstruct' traditional myths and beliefs. This is an area that Eco-School support workers could reflect on further.

The rules surrounding the deployment of indigenous knowledges in the Eco-School also pose significant ethical questions for WESSA about the ways in which knowledge systems are positioned if they result in a hierarchy of these systems, and the ways in which various knowledge systems are validated. Within the South African Eco-School, certain types of knowledge are taught and particular knowledges are sanctioned, while other knowledges are dismissed or downgraded to superstitious beliefs.

Interestingly, many teachers in South Africa do not hold these 'superstitious beliefs'. As Masuku van Damme and Neluvhalani (2004:356) argue, South African teachers have paradoxically become 'active participants in the subjugation of [their] own local ways of knowing' through their participation in post-apartheid processes of educational reform. Thus, many teachers have already internalised and proactively endorse the illegitimacy of their own knowledges and cultures. So, many Eco-School support workers, who are on the one hand seeking to dismantle and deconstruct traditional 'beliefs', are on the other hand attempting to mobilise the take-up of indigenous knowledges through their Eco-School work. What seems to separate indigenous 'beliefs' from indigenous knowledges for Eco-School workers is whether or not the knowledge follows three key rules:

1. Indigenous knowledges are environmentally friendly and sustainable.
2. Indigenous knowledges are validated through scientific knowledge.
3. Indigenous knowledges are static and rooted deep in history.

Rule 1: Indigenous knowledges are environmentally friendly and sustainable

WESSA actively encourages and supports the integration of indigenous knowledges across all areas of the curriculum, but specifically targets this through its Community and Heritage theme. An examination of the WESSA Eco-Schools handbook (WESSA, 2016) shows that WESSA actively encourages and supports the integration of indigenous knowledges across all areas of the curriculum (see Table 2 for sample activities).

Many of the activities listed above refer to traditional materials and practices that are environmentally friendly or sustainable. For example, reference is made to natural materials found in the environment for building, and making clay and plant fibre objects and natural musical instruments. Traditional practices that promote positive environmental beliefs and blueprints for sustainable societies such as those found in the ethic of *ubuntu* are also featured in the handbook. Such inclusion presents this knowledge as appropriate and valid. Indigenous knowledges that are not environmentally friendly or that lead to environmentally destructive practices are either omitted from the handbook, or if included, are critiqued as superstitious 'beliefs' and not given the status of 'acceptable' indigenous knowledge.

Limiting what counts as indigenous knowledge in this way runs the risk of constructing and representing indigenous peoples as those living close to the land, attuned to or part of nature, and living in balance with their environment (Berkes, 1999). This romanticisation of indigenous peoples and their knowledges creates an uncritical, essentialised and homogenised view of indigenous peoples as either noble savages (Neumann, 2000), or ecological warriors (Davis, 2006) who are uniquely endowed with some esoteric secret knowledge required to save the

planet. Such a view 'fixes' indigenous people to an imagined green utopia of pre-modernity, granting these people value only when they are living traditional lives. While at first glance efforts to incorporate indigenous knowledge may appear to be positive, the risk is that such efforts may do nothing more than reproduce the notion of a primitive, exotic Other. What this does is reify the noble savage of the past while representing indigenous peoples of the present as fallen angels who have been contaminated by development and modernity and who are now often seen as a threat to the environment (Berkes, 1999; Neumann, 2000). It is therefore important for environmental educators to challenge any homogeneity of indigenous knowledges evident in the field and instead seek to ensure that such knowledges are not fixed or relegated to a romanticised green utopian past (O'Hern & Nozaki, 2014; Shava, 2008).

Table 2. Selected activity suggestions from the Eco-Schools handbook

Subject	Eco-School theme	Activity suggestion
Year 4		
Natural Sciences/ Technology	Community and Heritage	• Structures for animal shelters. Issues of animal welfare and needs of animals in terms of shelter can be explored. This can sometimes be linked to mistreatment of animals within the community as an issue. • Exploration of indigenous structures and traditional homes – use of natural materials found in the environment. • Cultures and moral lessons – look at different cultures in South Africa, what foods do they eat? What beliefs do they have regarding the environment? What traditional knowledge do they have that is a good environmental practice?
Year 5		
Natural Sciences/ Technology	Community and Heritage	• Traditional processing and African use of natural materials. Making an object from clay and finding examples of objects made from plant fibre.
Year 7		
Creative Arts	Community and Heritage	• Response to different stimuli – stimulus could be a theme (corresponding with school's action project, i.e. extending our hand to those around us/traditional living), idea (e.g. *ubuntu*), story, pictures (of an environmental issue), music (traditional music/music from different cultures).

Rule 2: Indigenous knowledges are validated through scientific knowledge

Through its Share-Net Programme, WESSA also distributes environmental education resources to support South African Eco-Schools in integrating indigenous knowledge perspectives (Masuku Van Damme & Neluvhalani, 2004). These resources grew out of several research projects conducted over the past two decades that began the painstaking task of recovering what had been marginalised and forgotten over decades of colonial domination

and apartheid. Projects on topics such as Nguni grain storage (Mtshali cited in Masuku, 1999), traditional 'sweet water' collection practices (Manqele, O'Donoghue, Masuku, Le Roux & Ndlovu, 1998), traditional uses of *Ziziphus mucronata* (buffalo thorn tree) and beer production (Hanisi in O'Donoghue, Lotz-Sisikta, Asafo-Adjei, Kota & Hanisi, 2009) have provided the basis for the principal and authoritative indigenous knowledge resources used by South African Eco-Schools.

An example of these resources is *Umqombothi: Beer, ants and ancestors* (WESSA Share-Net, n.d.), which provides a case study of how indigenous knowledges contributed to addressing problems of earlier times. The resource provides an overview of the traditional practice of making sorghum beer, and the value and uses of the beer and its by-products. A sample extract from this resource shows how indigenous knowledge is presented (italics in original):

> Nothing was wasted from the beer making process. The froth at the top was skimmed and kept in the hut for baking purposes as it has a high yeast content. Women frequently made dumplings (ujeqe) with the yeast from beer making. *The froth was a result of alcoholic fermentation which takes place because the sprouted sorghum that was added in the last stages of brewing contains sugars, glucose, and fructose. These decompose into alcohol and carbon dioxide. The enzymes responsible for decomposition are zymase, maltase and invertase. The active ferment in this case is yeast or saccharomyces, and the process is called alcoholic fermentation. Because the surface froth in sorghum beer has a high content of yeast, it was traditionally used for brewing and baking.* (WESSA Share-Net, n.d.:2)

In this extract, the indigenous knowledge and practice is first presented, outlining how the froth at the top of the beer was kept for baking purposes and for making *ujege* (dumplings). Secondly, in italics underneath, a scientific explanation for this phenomena is provided, describing why froth makes such a good raising agent for further baking activities. This same format is repeated several times throughout the resource. Although these materials were written with the aim of opening opportunities for inter-epistemological dialogue, encouraging teachers to interplay scientific and cultural knowledges (Masuku van Damme & Neluvhalani, 2004), one could also argue that presenting knowledge in this way encourages a practice whereby indigenous knowledges are only validated when supported by scientific explanations.

Validating indigenous knowledges through scientific explanations is common in WESSA Eco-School practice. This is illustrated in the following discussion with Eco-School support workers:

> ESW3: I think it's a great opportunity to look at cultural practices or knowledge that has been passed down and to look at it critically, and very often you'll find indigenous knowledge that is beneficial to the environment and it might be coincidental but often there's a reason which when it first came about, they wouldn't have had the scientific reasons for it. Like that first sweep, when you want to drink water from a natural water resource, if you look at the number of contaminants or pathogens or bacteria in that top layer that

is normally what would make you sick. So that would be something to be encouraged and people that practice indigenous knowledge feel really affirmed get really excited when their practices are approved of, or …

ESW4:   …given a scientific explanation

ESW3:   You know in a kind of like a 'told you so' way, but then there are some other practices, which I think this is where environmental education needs to be at the forefront of is to look at them critically and have a voice to say 'It doesn't have a place anymore, it's not good for people or the planet'.

(Eco-School Support Workers 3 and 4, 2012)

Both these extracts reflect a tendency to define or explain indigenous knowledge in relation to science (Masuku van Damme & Neluvhalani, 2004; Semali & Kincheloe, 1995), demonstrating that western science is the dominant standard by which other knowledges are judged. This sets up a hierarchy of knowledge systems. If environmental educators are genuinely concerned about enabling epistemological pluralism, we need to ensure that we do not privilege any one knowledge system, be it indigenous, local, religious or scientific (Odora Hoppers, 2002). To not do so means we run the risk of subsuming diverse knowledges into the 'language and logic of western knowledge systems' (Shiva, 2000:viii).

Rule 3: Indigenous knowledges are static and rooted deep in history

Another rule that emerged from interviews with Eco-Schools support workers concerned how long-standing the indigenous knowledge was. This is clearly illustrated in the following conversation between two Eco-School workers (emphasis mine):

ESW3:   There's also recently, and *it's been called indigenous knowledge but it's not really*. People have been poisoning vultures up in Zululand. So what they do is they either kill an animal, or leave a carcass, and they put a certain kind of poison in it ... And everything comes down to eat that carcass including vultures *hyenas, the whole lot ... they just all die*. And they take the vulture's necks and they make that into 'muthi' ... and they make a necklace out of it hang it around your neck and people have been told this will give you the power to see the lotto numbers.

ESW4:   *And these are not old people, these are young people!*

ESW3:   Yes! So it's *capitalising on a current trend*, wanting to win the lottery.

ESW4:   It's based on the fact that vultures circle very high so they can see everything, including the future.

ESW3:   Nowadays the 'muthi' industry has grown so big that they have collectors going out to collect stuff.

ESW4:   *... who are not trained*

ESW3:   Yes, and a lot of 'inyangas' haven't been *properly initiated* or taught or anything.

ESW4:   They're just anyone …

ESW3:   They've just learnt a little bit and taken it up. So when we've discussed it in class with lots of Black children, *we've discussed how we've actually moved away from our traditions in a sense*.

ESW4:   But it's a *broken down telephone as well, because a lot of indigenous knowledge is passed down orally and because the family structure isn't …*

ESW3:   … in place ...

ESW4:   … in place, it can *morph into things suitable to the current situation*, like the lottery.

(Eco-School Support Workers 3 and 4, 2012)

Although this conversation reflects aspects of Rule 1 (indigenous knowledges are environmentally friendly), it also reveals a dismissal of vulture *muthi* as indigenous knowledge: 'it's been called an indigenous knowledge thing but it's not really'. The speakers make several references linking this 'belief' to current or contemporary events such as 'seeing lotto numbers', 'capitalising on a current trend', and 'suitable to the current situation', and use this as an argument for discounting the authenticity of such knowledges. Furthermore, they create a binary between 'current' *muthi* collecting practices and 'traditional' practices by claiming that the *muthi* collectors and *inyangas* (medicine men/women) involved are not properly trained or initiated. They argue that such practices are the result of family structures breaking down and a moving away from tradition. These developments have resulted in problems with the passing down of indigenous knowledge between generations. Thus, for these Eco-School support workers, authentic indigenous knowledges are rooted in historical tradition, they come from the past, and are timeless and unchanging. New 'knowledges' that arise as a result of interactions with new socio-economic factors and contexts are viewed, not only as inauthentic and untrue, but also as deceitful, dangerous and unsustainable. To be clear, we are not defending the veracity of claims about vulture *muthi* or arguing that these should be accorded knowledge status, but merely pointing to the way these unspoken rules define what is counted as legitimate indigenous knowledge in the Eco-School.

The adherence to this rule by Eco-School workers results in valid indigenous knowledge being understood as only that which is a 'static repository of pre-colonial knowledge'. This fixes the speakers and holders of such knowledges to the past, thereby rendering them almost irrelevant to solving the challenges of contemporary life. Were such knowledges not relegated to the past in these ways, then they could become part of a dynamic, changing, learning process that would enable us to engage in new ways with new social and environmental conditions (Goodall, 2008; Shava, 2008).

Conclusion

The effects of the colonial subjugation of indigenous knowledges are still experienced by South African teachers, many of whom have internalised the illegitimacy of their own knowledge systems. Thus, efforts to re-appropriate and value indigenous knowledge systems may not only open up much needed sources of epistemological diversity (considering the complex wicked problems facing the planet) but also offer counter-hegemonic ways of recovering pride and national identity. However, efforts to build an epistemologically pluralistic curriculum where indigenous, cultural and scientific knowledges can coexist is not without problems. In their efforts to build such a curriculum, Eco-School support workers working at the discursive interface of different knowledges systems appear to have generated a set of discursive rules that identify what constitutes legitimate knowledge in the Eco-School. These rules, while privileging scientific knowledge, do enable the inclusion of certain indigenous knowledges. In particular, indigenous knowledges that are environmentally benign, validated by science, and rooted in historical traditions are considered legitimate forms of knowledge to deploy in and through the Eco-School.

While hesitant to confront contradictory discourses, Eco-School support workers employed a number of strategies to assist their negotiations of this discursive friction. These strategies included looking for deeper meanings behind traditional stories, recognising and appreciating the empirical basis of traditional stories, asking critical consequential questions, and adopting the language of other powerful discourses. These strategies together ensure that Eco-School support workers are able to influence and shape the thoughts and practices of Eco-School teachers about what constitutes valid knowledge.

However, indigenous knowledge discourses are still emerging as shifting, complex social constructs, particularly as they relate to other discourses within a diverse epistemological framework. It is clear that more thought needs to be given to the role and place of indigenous knowledge in Eco-schooling, particularly in its relationship to dominant western scientific ways of knowing. The difficulty of working with indigenous knowledge in ways that do not reflect simplistic binaries between western scientific and indigenous knowledges, which privilege certain forms of knowing over others, is significant within South Africa's Eco-schooling context. Such practices may have unintended consequences affecting the ways that indigenous peoples are represented and valued.

Notes on the contributors and their contributions

Lead author

Ryan, Elizabeth (Lisa) | Southern Cross University |
ORCID 0000-0003-0688-0945 | Lisa.ryan2@sunshinecoast.qld.gov.au
Dr Lisa Ryan is Environmental Education Programming Officer at Sunshine Coast Council and Adjunct Associate Lecturer at the University of the Sunshine Coast. Her most recent research is in postcolonial theories of identity and agency in the Eco-school. Dr Ryan was affiliated to the Southern Cross University at the time of producing this research paper.

Co-author

Ferreira, Jo-Anne | Southern Cross University |
ORCID 0000-0002-3448-1477 | Jo-anne.ferreira@scu.edu.au
Prof Jo-Anne Ferreira is Director, Centre for Teaching & Learning and Academic Director, SCU Online at Southern Cross University. Her research is in post-structuralist theories of identity, embodiment and power in environmental and sustainability education

Percentage contribution

| Areas of contribution	Authors	Percentage contribution
Conception or design of the paper, theory or key argument	Lisa Ryan	*60%*
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Data collection	Lisa Ryan	*100%*
	Jo-Anne Ferreira	*0%*
Analysis and interpretation	Lisa Ryan	*70%*
	Jo-Anne Ferreira	*30%*
Drafting the paper	Lisa Ryan	*80%*
	Jo-Anne Ferreira	*20%*
Critical review of paper	Lisa Ryan	*50%*
	Jo-Anne Ferreira	*50%*

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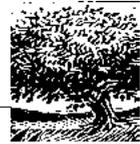
Environmental education from an intercultural approach: A glimpse into Latin America

Helio Manuel García-Campos, Universidad Veracruzana, Mexico

Abstract

Latin America has established a new model of higher education termed intercultural, or indigenous, education. This essay analyses the potential that the integration of educational approaches focused on environmental sustainability and linked to intercultural education approaches could represent to Latin American institutions. The trend has set a new direction and opened up perspectives on integrating other fields, such as ethnoscience, agroecology, education and applied anthropology. Different aspects of the relationship between culture and nature are analysed, bearing in mind that biocultural diversity and its territorial expressions are part of a heritage that rural and indigenous societies present as a contribution to the current definition of civilizatory trends. Based on this review, the paper presents a comparative and integrative conceptual framework that can be used as a reference for practical applications of experience or as a search tool for educational alternatives that can bridge the gap between environmental and intercultural education.

Keywords: environmental education, intercultural education, intercultural universities.

It is interesting to note how, as problematisation fields, interculturality and sustainability view each other and establish a mutual dialogue within many intercultural higher education programme and policy proposals. Moreover, proposals based on the knowledge and traditions of indigenous or mestizo peoples – while avoiding the idealisation of these peoples – provides meaning and viability to alternative perspectives on sustainability and warns against discussions about 'universal sustainability' when *culturally differentiated sustainability* should be acknowledged instead. Hence the importance of addressing this perspective from an intercultural point of view.

In general, when scholars, teachers and students of the humanities and the social and natural sciences make frequent explorations or interventions into rural and indigenous worlds, they learn indigenous peoples' visions and strategies or make them visible, which then contributes to showcasing the contemporary viability of these world views and practices, and to highlighting new pedagogical possibilities.

The potential that this endeavour represents for Latin America is recognised by authors such as Ramos-García, Tenorio and Muñoz (2011), and Castaño-Cuellar, Pacheco and Bustos (2011), who pursue pedagogical proposals of education on natural science and environmental issues in intercultural contexts, as well as Castaño-Cuellar (2011), who focuses on the teaching of biology in bio-diverse and multicultural countries.

To begin with, we raise some pertinent questions. How, or in which way, can peoples and cultures with the lowest ecological footprint on the planet be taught sustainability? How can we learn from them in order to come to a new understanding of, and transform, societies that are based on the vision of progress and consumeristic, industrial urban development?

Interculturality assumes the possibility of dialogue among the different visions coexisting within the framework of multicultural societies such as those of Latin American countries, and beyond that, the real possibility of enabling mestizo or highly 'westernised' sectors to acknowledge the relevance of native or Afro–American peoples' knowledge, and, vice versa, of enabling indigenous peoples' to integrate modern science into their knowledge systems. What would the form of a pedagogical perspective be that allowed for the coexistence and mutual enrichment of indigenous and rural knowledge and the knowledge of scientific culture? Discussing these matters leads to the identification of certain elements that inform a proposal for an intercultural environmental education for sustainability (IEES) approach in the current field of environmental education.

Mexico and Latin America are witnessing a dynamic process in which intercultural universities, also known as intercultural institutions of higher education (IIHEs), are being established (Mato, 2009). These institutions seek to counter the enfeeblement of those cultures and societies that have been endemically put at a disadvantage by the predominance of the western cultural model, which expresses itself at every level of society and education. Responses to this situation are included in current intercultural policies aimed at promoting and fortifying native cultures on the American continent.

A common element among Latin American IIHEs, and in fact among all Mexican intercultural universities, is the presence of formal, professional, academic programmes focused on various aspects of sustainability. Hence the interest in exploring the rationale and the theoretical, political and axiological elements that could underpin the fusion of interculturality and sustainability, especially as a result of the frequent postulation that indigenous or rural peoples, as well as peoples of African ancestry, possess epistemological and axiological knowledge that transcends the anthropocentric perspective of colonial European cultural heritage. Such a postulation is considered as having the potential to renew and re-define the discourse on sustainability and sustainable development.

Sustainability is not a universally acknowledged concept. In other words, it is not co-validated identically by every contemporary multicultural code. However, we propose the existence of certain equivalences between concepts rooted in traditional or indigenous knowledge systems and the definitions of sustainability developed from a scientific perspective over the past two decades. In fact, evidence for many of the concepts and strategies associated with sustainability has been easier to locate among indigenous and rural societies and communities. Hence the importance of these 'rural' societies:

> which still today include around two billion people who belong to autochthonous rural or scarcely modern rural worlds, as well as 400 million people who belong to indigenous worlds [these worlds] are better prepared to endure the deep crisis scenarios that lie ahead of us, [because they are] the least modern and urbanized societies. As the global expansion of capitalism and its urban-agro-industrial system reach their frontiers. *(Fernández-Durán, 2010:59–60)*

The matter goes beyond Fernandez–Durán's conceptualisation here, and is not just related to natural resource management strategies only: it represents a more complex configuration

that entails ontological, epistemological, ethical and political considerations that could have consequences for global civilisation.

This paper identifies some of the trends and elements that have led to the elaboration of proposals and policies that acknowledge IEES.

From sustainability to interculturality in a globalised world

The fields of sustainability and interculturality are relatively recent, and they respond to various expressions of the contemporary crisis – one of them from a socio-environmental perspective and the other from a cultural perspective. Although complementary ethical, epistemic and methodological relationships between both fields can be implicitly and practically assumed, there are few studies that seek to establish their existing or possible points of convergence with the intention of creating a highly pertinent transdisciplinary space in which to search for answers to the crisis.

Environmental education for sustainability (EES) and intercultural education (IE) are today essential parts of a promising line of enquiry. Because of their chronotopic condition (De Alba Ceballos, 2009), both conditions are bound to create and provide for theoretical and pragmatic approaches based on cultural and bio-ecological/environmental diversity aimed at constructing or re-formulating pertinent cultural, environmental and educational reflections, critiques, proposals and practices. In a similar vein, Leff, Argueta, Boege and Porto-Goncalves (2005:5) state that:

> the globalisation process presents three fundamental challenges to sustainability: the conservation of biodiversity and the planet's ecological balances; democracy, social participation, and cultural diversity; knowledge, education, training, and information available to the citizenry.

Sustainability and interculturality should be combined so as to seek the answers required of a necessarily complex review. However, acknowledging the myriad perspectives on sustainability and interculturality calls for an inquiry into, and analysis of, the nature of the dialogue between these fields that takes into account their core ideas and epistemological, political and pedagogic principles.

'Sustainability' is a relatively recent concept, and, as such, it is not universally known or understood, even among the population that acts within the framework of contemporary western knowledge and culture itself. It is also probably not a concept that has been internalised by the citizen or within the general mental framework of western human consciousness. Likewise, it is unlikely an equivalent connotation could be found among indigenous cultures, particularly among the Mesoamerican,[1] Andean or Amazonian cultures of Latin America. This lacuna also occurs with the other term commonly associated with sustainability, namely, 'development'. Viteri-Gualinga (2002:2) writes that this is due to:

> the lack of a linear life process that establishes what development or underdevelopment are or their previous or future states, a dichotomy people must go through in order to achieve a

desirable life, as it is in the western world. There are also no concepts of wealth or poverty
determined by the accumulation or lack of material goods.

This fact, however, should not impede the search for possible 'equivalences' that indigenous
cultures might possess with regards to the concepts of 'development' and 'sustainability' such
as, for example, the corresponding Andean–Amazonian concept of *súmak káusai*. There is
now a growing number of references to recent processes and initiatives in which South
American nations, such as Ecuador and Bolivia, have included this concept in their national
constitutions. In 2009, in a process termed the 'biocentric turn' by Eduardo Gudynas (2009), the
circumstances were ripe for this change because of the administrations of progressive presidents
in both countries, and, in the case of Bolivia, the first indigenous president.

Súmak káusai is usually defined as 'living well' or 'harmonious life' (Gudynas, 2009; Mato,
2008; Viteri-Gualinga, 2002; among others), or 'living well, being well' (Vargas-Callejas, 2005),
with the proviso that this type of living must be based on respect for the *Pachamama* (Mother
Earth) in correspondence with the well-known idea shared by indigenous cultures that
humankind is part of nature.

More recently, in the Mexican state of Chiapas some academic and social actors have also
begun to incorporate this 'living well' concept (*lekil kujlejal*), based on a common matrix of
principles shared by peoples such as the Tojolabal, Tzotzil, Tzetzal, Ch'ol and Zoque (Sartorello,
Ávila & Ávila, 2012).

Based on studies by anthropologists and ethnoecologists, Leff *et al.* (2005:21) state that:

> many ecological and cultural conditions of sustainability have been incorporated into production
> practices of 'traditional' societies and are reflected in both their symbolic formations and their
> technological tools, which have been configured after long processes of coevolution with nature,
> environmental transformation, and cultural assimilation. Production practices based on cultural
> symbols inspired by the environment, religious beliefs, and social meanings assigned to nature
> have resulted in different forms of perception and appropriation, social rules for access and usage,
> ecosystem management practices, and production and resource consumption patterns. This is
> how traditional agricultural ideologies and productive strategies were configured in Mesoamerica.

Supported by the struggles of indigenous peoples, their organisations and their representatives
throughout the world, this is a long process, one in which different national and international
pieces of legislation have gained legitimacy by being informed by a legal pluralism emanating
from cultural diversity. There are common underlying elements and visions that lead to the
recognition of indigenous knowledge and the rights of native peoples to take ownership
of nature because they are part of a strategy to counter the hoarding and plundering of
resources and biodiversity taking place in their territories, and who are frequently threatened
by governments and private corporations driven by the neoliberal vision of unlimited
economic growth.

It is because of the wealth of knowledge, visions and ethics held by native peoples contributing
to the construction of contemporary responses to planetary and civilising dilemmas that such

knowledge must be advanced because of their potential to renew educational discourse and initiatives. However, it is necessary to transcend the clichéd and romanticised depiction of the efforts to redeem indigenous cultural values, since these values themselves are vulnerable to deterioration and transformation in the hands of modernisation and globalisation.

Interculturality addresses sustainability

In the same way that EES has failed to embed perspectives of cultural diversity in its curricula, intercultural studies and intercultural education have also failed to integrate environment-related themes and socio-environmental sustainability considerations into their programmes.

At first, it would seem that intercultural studies, including intercultural education, fail to consider sustainability as forming part of the 'diverse academic currents which signal deep transformations in the objectives of the social sciences' (Dietz, 2003). This is probably because sustainability – an interdisciplinary field that has not yet been incorporated into social science as comprehensively as other, already-established fields – is seen as being more directly related to environmental and technical disciplines. This view overlooks the fact that, compared with its ecological component, sustainability does a better job of incorporating the social, political, and cultural dimensions necessary for a holistic approach.

If we consider that intercultural studies are the result of multiculturalist movements that have gradually embraced the discourse of interculturality as part of the current evolution of the discussion, they must be considered an important part of anti-globalisation social movements that challenge what De Sousa Santos (2007) calls *abysmal thinking*. This is a mindset that separates the western tradition from non-western world views and leads to global cognitive injustice. For that reason, such movements – their thinkers and their leaders – advocate new forms of utopianism and view the promotion of social, ethnic and epistemological equity as a constituent part of the interculturality–sustainability dyad. Even if the terms *sustainability* and *interculturality* are never used by many indigenous intellectuals and leaders (or even by scholars who study these matters), there are certainly other expressions more or less equivalent to such a terms, and thus, as previously stated, it becomes relevant to explore the new paradigm of what is known as *súmak káusai*.

Such an equivalence would be difficult to translate inter-linguistically because of various epistemological constructs differentiated by culture. In view of the lack, or even the nonexistence, of conceptual and idiomatic translocation of concepts such as interculturality and sustainability among indigenous cultures, an intuitively adequate way to establish a point of reference that bridges and allows for intercultural dialogue begins by identifying the particular visions that these cultures have, as well as their cognitive outlook, ethics and practical approach to the relationships between society, culture and nature. In this regard, ethnosciences, their principles and their methods are currently providing some of the best possible ways to reveal paths and resources that could establish a dialogical exchange of knowledge, both academic and otherwise *(diálogo de saberes*, Leff, 2004) around the interculturality–sustainability agenda.

Despite that fact that these 'local models of the natural world form the base of today's environmental struggles' (Escobar, 2003:78) and that they also form the base of what are

considered social ethnoecological movements, a direct original response to the 'Eurocentric world' and the dominance of 'modern instrumental rationality', these last two ideas still represent a strong opposition to them and deny the evidence that 'this vision spells doom to a regime that intertwines biology and history, supported by the capitalisation of nature and work' (Escobar, 2005:88).

Toward a comparative synthetic perspective

With the intention of exploring some of their characteristics, the following table summarises a proposal that allows for a possible comparative vision, and eventually a synthesised vision of the components of an IEES. The main purpose of this exercise was to establish a basic conceptual key for exploration when integrative projects are applied to sustainability and interculturality. Certainly, economic, technological or spiritual dimensions, among others, could also have a place in this matrix, and could be analysed in the same comparative and complementary sense.

Table 1. Complementary characteristics of environmental education for sustainability (EES) and intercultural education (IE), with a view to establishing a synthesis for intercultural environmental education for sustainability (IEES)

	Environmental education for sustainability (EES)	Intercultural education (IE)
Ethics	• Interdependence between nature and society. • Transgenerational responsibility toward the satisfaction of future human needs. • Some indigenous visions attribute rights to nature as well as to human beings.	• Recognises multiculturalism as a fact. • Promotes the need to accept others who are culturally, generationally, or generically different. • Recognises the need to be empathetic and be able to adopt diverse identities in order to understand the 'other's' conditions.
Globalisation	• Considers generalised phenomena that result in environmental degradation (climate change, loss of biodiversity, etc.) and affect environmental processes and local ecosystems.	• Acknowledges the phenomenon and processes of exchange flow between human populations from different countries and cultures. • Addresses problems associated with the coexistence between different ethnic or social groups and promotes tolerance and dialogue.
Location *(Note: Use of the term 'geolocation' is an attempt to resolve these two issues.)*	• States that the management of environmental issues and local resources can be better accomplished by using a local or bio-regional perspective and potentiating the specific characteristics of each context in educational terms.	• Identifies and encourages responses that seek an affirmation of local identities as a basic and pertinent solution to the erosion of local culture in the face of globalisation.

	Environmental education for sustainability (EES)	Intercultural education (IE)
Diversity	• Bio-ecological diversity is the result of temporal processes and pulses of nature at different scales. • This baseline represents the best opportunity to preserve the functioning of ecosystems by virtue of the richness of possible responses to ecosystem disruptions.	• Refers to cultural diversity. • Involves the recognition and strengthening of local cultures, not only from the ethnic point of view. • Is the most important resource in potentiating political and organisational responses. • Cultural diversity provides better response opportunities to the imposition of monocultural processes advocated by the hegemonic globalising discourse.
Knowledge	• Utilises an interdisciplinary repertoire as the most appropriate response to the complexity and multidimensionality of factors involved and the conditions for coexistence between society and nature.	• Emphasises and favours the value of local knowledge and creativity but considers the existence of exogenous knowledge. • An 'ecology of knowledge' in interaction that thrives under a dialogue maintained in conditions of epistemological equity.
Culture	• Considers that the environment, ecosystems, and biological species are frequently products of co-evolution between culture and nature. • A major resource to preserve biocultural heritage associated with indigenous regions, biological conservation, and the strengthening of cultures.	• By recognising multicultural reality, promotes dialogue and mutual respect between members of different cultures. • Puts forward the recognition and strengthening of local and indigenous cultures before the influence and imposed threat of monocultural processes driven by globalisation and resulting in cognitive injustice.
Nature *(Note: In Mexico, there is an ongoing discussion about the biocultural heritage or biocultural memory of indigenous peoples, a proposal based on recognising the complexity of the relationships among society, culture and nature.)*	• A matrix for the survival of all species, civilisations, and cultures into which individuals, communities, and societies metabolise their basic biophysical relationships as they 'environmentally exists'.	• Recognises its role in cultural inspiration and creation (mirror and identity of peoples). • In many Latin American countries, the current trend recognises nature's rights (Mother Earth, *Pachamama*) even at the constitutional level.

	Environmental education for sustainability (EES)	**Intercultural education (IE)**
Policy/ organisation/ regulations	• Promotes the values of democracy and citizenry participation and education in the reappraisal of nature as *commons* as opposed to the hoarding and monopolisation of natural resources. • Sympathetic toward the emancipation of minorities from the negative consequences they suffer *(environmental justice).*	• Recognises and promotes the value of local institutions and the legal plurality of indigenous peoples who coexist with 'national societies'. • Seeking social equity for indigenous peoples and minorities within multicultural nations is a priority.
Sustainability	• A complex, multidimensional vision. • Goes beyond the frequent equivalence of sustainability = environment conservation and improvement. • Favours the 'strong' or 'super strong' current that criticises and challenges the system (establishment).	• Not every culture, especially the indigenous cultures, possesses an equivalent concept. • While a polysemic concept, even in western cultures, it seeks the recognition of correspondences or indicators of indigenous cultural values similar to some notions of sustainability.
Educational streams	Ethnographic environmental education; popular environmental education; multicultural environmental education; eco-pedagogy.	Multicultural education; indigenous education; citizen education; intercultural pedagogy.

Conclusions

A promising approach to strengthen the relationship between environmental education for sustainability and intercultural education focuses on the 'culturalisation' of environmental education, thus creating standpoints from which to reflect on the differences between cultures and directing relevant efforts toward the construction of complex concepts such as sustainability (a term that has not been universally understood from the postulates of scientific and western discourses). This is done by incorporating the practices and visions of traditional societies, which are based on ecological and cultural conditions of co-evolution between society and nature, and which have been acknowledged and made part of the deontologic code of sustainability.

Intercultural education, particularly in Latin America, makes a priority of addressing the concerns of indigenous and Afro-American populations. However, the construction of innovative paths – originating in intercultural sources of knowledge and the intercultural discourse itself – should also attempt to broaden the concept of those 'others' who should be included in the discussion toward a biocentric dimension. As Eduardo Gudynas (2009) would put it, the 'others' include all the other species sharing the Earth with humankind.

Specific possibilities of application in this sense are visualised, for example, through the promotion and exchange of knowledge between actors of cultures, peasants, indigenous people and those professionals or university students from the mestizo cultures, through productive projects (agriculture, forestry, livestock and domestic plots) that would aim to achieve the careful extraction and use of nature's resources. Overcoming the hierarchies among experts and advisors would promote co-learning. The technicians would participate in the development of their own production and conservation strategies, learning to build a relationship that is different to the typical one of simple technology transfer.

Furthermore, in the field of health, there already exist important examples where differentiated medical systems are contrasted – such as the traditional indigenous types (herbalism, midwifery) and the modern allopathic model giving rise to the desired dialogical exchange of knowledge–wisdom (*diálogo de saberes* as per Leff, 2004), which is proposed as worthy goal in the processes of intercultural dialogue.

The growing presence of intercultural universities, most of them located in predominantly rural and indigenous territories, creates favourable conditions for promoting the development of an environmental education for sustainability arising from a rural context in 'situated' or 'localised' educational or intervention modes that take into account the specific environmental and cultural contexts of those territories. Such predominantly rural regions are not exempt from the negative effects of the urban–industrial/agro-industrial model of civilisation, but it is with regards these environments where the possible future direction of civilisation needs to be discussed.

Even though IEES proposals are currently directed at indigenous peoples, the focus should be redirected towards the questions of why and how native peoples' traditional knowledge and cultural heritage are pertinent with respect to re-creating contemporary culture and civilisation on the entire planet. It is essential to know how the 'ecology of differences' can flow in both directions, toward the different social and cultural groups of particular locations, regions, nations and continents and toward the planet as a whole. The central question is how influences can be made mutual by promoting an 'ecology of knowledge–wisdom' (De Sousa Santos, 2007) to bring about constant, commonplace and creative dialogue.

Endnote

1. Mesoamerica is a historical region and cultural area in North America. It extends from central Mexico through Belize, Guatemala, El Salvador, Honduras, Nicaragua, and northern Costa Rica, and within this region pre-Columbian societies flourished before the Spanish colonization of the Americas. In the 16th century, European diseases like smallpox and measles caused the deaths of upwards of 90% of the indigenous people. It is one of five areas in the world where ancient civilization arose independently, and the second in the Americas along with Norte Chico (Caral–Supe) in present-day Peru, in the northern coastal region. (Retrieved from: https://en.wikipedia.org/wiki/Mesoamerica [accessed 27 May 2019])

Notes on the contributor

García–Campos, Helio Manuel
Center for Ecoliteracy and the Dialogue of Knowledges, Universidad Veracruzana, Mexico
ORCID: 0000-0002-3256-9707 | helgarcia@uv.mx; gc.helio@gmail.com
A biologist by training, Professor García–Campos has worked in the field of environmental education related to grassroots organisations in protected natural areas and environmental social movements. He lectures on intercultural and biocultural heritage issues.

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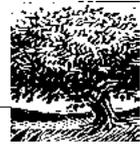
Education for Sustainable Development at the problem–posing nexus of re–appropriated heritage practices and the science curriculum

Kenneth Mlungisi Ngcoza, Rhodes University, South Africa

Abstract

Indigenous knowledge is approached as an adaptive and responsive sphere of Mother Tongue meaning-making and innovation, an indigenous epistemic capital that has been marginalised by continuing colonial modernity and an associated urbanisation in Africa. The exclusionary and epistemicidal impacts of colonialisation and the hegemony of meanings imposed in a westernised curriculum have played out as a double blow impeding many learners from relating knowledge to the world they live in and achieving their potential in the sciences. Research on indigenous knowledge and schooling is reviewed to critically explore this premise. A dissonance between prevailing theory, changing socio-cultural realities and diversity in urban classroom contexts is also probed. This enabled us to contemplate a Mother Tongue re-appropriation of heritage practices amongst teachers, their learners and parents as urban custodians of indigenous knowledge and to work with this as situated heritage practices for working with the modern scientific knowledge in the school curriculum to contemplate future sustainability. Mother Tongue re-appropriation is thus proposed as a starting point for a research collaboration to enhance epistemological access to decontextualised scientific knowledge in the curriculum and for exploring how this might be achieved in ways that open up a 'third space' of empowering socio-cultural innovation through Education for Sustainable Development (ESD).

Orientating background

Indigenous knowledge systems (IKS) are seldom reflected as a dynamic outcome of situated processes of continuing knowledge generation and innovation in response to changing socio-cultural and ecological conditions (Mavuru & Ramnarain, 2017). According to Mavuru and Ramnarain (2017), incorporation of learners' socio–cultural background creates authentic learning opportunities. It is recognised, however, that many intellectual discourses tend to represent IKS as situated systems that stand opposed to the ongoing hegemony of westernised science. The dialectical relationship here is commonly informed by the dialectic of critical theory and reflects a history of colonial conflict where westernised science appropriated indigenous knowledge, giving rise to global epistemicide (Barreto, 2014; Fataar, 2018). Critical realism, as a recent expansion of the 20th century critical project (Lotz–Sisitka, 2015) notes how different cultures can operate in the same space within a plural knowledge environment. We believe that the plurality of knowledges allows continuing critical projects to represent subjugated knowledges, reflect on epistemicide and contemplate learning across plural epistemic dispositions in a changing world. Plurality also promotes inter–epistemological dialogue, thereby creating epistemological access for indigenous learners and enabling reciprocal valorisation among the different epistemes in areas of resonance (Shava, 2016).

Contemplating a third space

In exploring these insights, we have drawn on Homi Bhabha (1994), who notes that subjugated knowledges can engage western cultural domination in post-modernity in a 'third space'. Following an extensive review of indigenous knowledge practices and social innovations, an open-ended 'third space' became apparent within dialectical processes of social innovation across indigenous knowledge practices and scientific knowledge in complex constellations of risk (O'Donoghue, Shava & Zazu, 2013). Figure 1 below reflects this as an open-ended dialogical process where Mother Tongue participants work together to 'bring out' and explore situated heritage practices. Working with these, they can also 'bring-in' modern institutional knowledge in a bridging process to open up a 'third space' within which to 'bring about' change for the common good (Lotz-Sisitka, 2017).

Figure 1. Adaptive transformation in indigenous knowledge practices
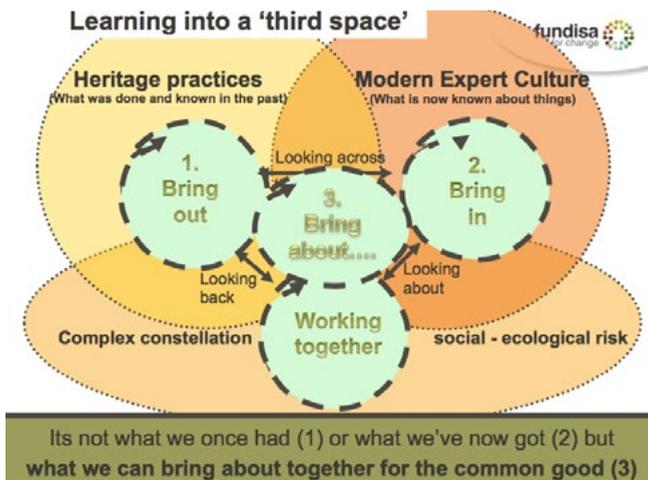
Source: Adapted from O'Donoghue (2015)

Social innovation work in a collaborative sustainability commons project provided insight into the adaptive knowledge systems of indigenous peoples in the Eastern Cape, South Africa. Here it was observed that, within modernist change and despite processes of appropriating marginalisation, many indigenous knowledge practices continue to be dynamic and responsive in changing times. Shava (2000) and Asafo-Adjei (2004) have noted how *imifino* (traditional leafy vegetables) have come to include numerous globally distributed naturalised plant migrants but with an unfortunate reduction in the use of indigenous species (Mtshali, 1994). The same innovative cultural processes are true of most indigenous knowledge practices related to fermentation (Hanisi, 2006; Kota, 2006; Mutanho, 2016), along with traditional composting (*Izala* – Zulu; *Ethuthwini* – Xhosa), as well as similar ways adaptations to climate variability (as in the Xhosa cultivation practice of *gelesha)* (O'Donoghue, Shava & Zazu, 2013).

Epistemicide and lack of epistemological and ontological access as barriers to learning

Alongside this evidence of adaptive knowledge transformation, most indigenous knowledge practices have receded in rural areas and have in many cases been lost to urban indigenous populations due to exposure to western livelihood systems and practices. In this way, current urban indigenous generations have suffered a double blow as a result of the lack of exposure to their knowledge heritage along with the experiential cultural capital to be able to successfully access the abstractions of modern scientific curriculum knowledge. Odora-Hoppers pointed to these intertwined processes of exclusion flowing from colonialism, when she noted to us[1] that one of the major barriers to indigenous students' success in science is their inability to recognise the knowledge as belonging to their socio-cultural and contextual heritage (Mavuru & Ramanarain, 2017; Odora-Hoppers, 2002; Webb, 2013). This invariably points to indigenous students' lack of epistemological access to westernised and decontextualised scientific concepts in formal education processes. Breidlid (2012:7) expands the scope of the problem with reference to the Xhosa by noting that:

> Since Xhosa pupils originate in an environment where knowledge is linked to spirituality, the encounter with modern schooling and the rationality of western epistemic hegemony[2] is often problematic. The potential lack of recognition of their own epistemological and spiritual background impedes the development of the pupils' full potential.

In support of these assertions, it is evident that much of the current ecological and botanical knowledge in the sciences was appropriated by early scientists within early western hegemonic trajectories of knowledge generation in interactions with indigenous peoples' knowledge and practices (Shava, 2008). Most of this epistemicidal appropriation developed with little (if any) acknowledgement and much without a full grasp of important contextual detail (Fataar, 2018). In this way, the full value of indigenous knowledges has been lost to indigenous peoples and the modern sciences, sometimes with an attendant lack of insight that results in a poor grasp of factors that are contributing to some of the current environmental problems that we face in a modern world. For example, *gelesha* (the practice of winter ploughing) was overlooked and reflected as a mystical practice associated with the rise of the Orion Belt rather than being exemplified as a water conservation practice to buffer the late onset of the summer rains.

Emerging dissonance between theory and the modern classroom context

In his study of the Xhosa in the context of the South African curriculum, Breidlid (2012:4) cautious against essentialism and in summary he notes that

> there are certain basic features of Xhosa cultural values, indigenous knowledges and identity construction which reoccur and which seem to cut across location, age group and gender.

He also states that the findings of his study 'fit well with the literature in the field' (2012:4), so it was notable that his analytical inscriptions did not resonate with being Xhosa for student teachers reading his dialectical analysis of the South African curriculum context since 1994. The dissonance in the student responses surfaced contradictions and tensions across the academic theory and the life and work experiences of young Xhosa students in a changing world. A key point to emerge was that the Xhosa are diverse, that there are notable differences between rural and urban areas, with the latter being most diverse and reflecting change with young people aspiring to be modern and not seeing this in conflict with being Xhosa (Webb, 2013).

The Breidlid discourse was useful for provoking deliberation on a wide number of curriculum and cultural propositions. Here the theory did not fit with the student teacher experiences of schooling or with the challenges of accommodating cultural diversity within complex and changing socio-cultural contexts of their classrooms (Cocks, Alexander & Dold, 2012; Mavuru & Ramnarain, 2017; O'Donoghue, Lotz-Sisitka, Asofo-Adjei, Kota & Hanisi, 2007). To this end, Cocks et al. (2012) propose that there is a need for cultural revitalisation. Masuku van Damme and Neluvhalani (2004) point to the westernised education system creating schizophrenic citizens due to its separation of indigenous learners' lived world and the decontextualised formal learning world processes. This is also alluded to by Lizop (in Ki-Zerbo, Kane, Archibald, Lizop & Rahnema, 1997) and Odora-Hoppers (2001) who describe how the western education system alienates learners from their lived contexts and how westernised schools were western islands within the community trying to erase and denigrate all indigenous knowledges from the minds of autochthonous learners.

Exploratory work on indigenous knowledge in classroom practice
In response to these complex problems of indigenous knowledge epistemicide (loss, exclusion) and educational failure, Maqwelane (2011) conducted an exploratory study on the inclusion of indigenous knowledge for enhancing literacy and learning across school, home and community. This preliminary work was taken into consideration continuing informal research using dialectical critical realism theory in teacher education between 2012 and 2014 (O'Donoghue, 2015). The continuing exploratory work allowed us to open up dialectical epistemic spaces of multi-literacy learning and social innovation around an educational engagement *in* and *with* situated heritage practices (O'Donoghue, Shava & Zazu, 2013). This work has allowed the framing of an urban knowledge re-appropriation partnership that explores indigenous knowledge in relation to the current science curriculum, thereby enabling epistemological access to scientific concepts for indigenous learners and reciprocal valorisation of knowledges in a learning context of plural knowledge representation.

Contemplating a bridging integration into a third space
The emerging epistemological challenge in education is the re-appropriation or representation of IKS in ways that allow scholars to bridge the divide between recovered cultural heritage and knowledge practices and modern scientific knowledge, whilst reviving work with indigenous epistemologies in the academy. An emerging research project will explore these dialectical

processes to enable participants to continue the novel and creative thinking that is evident among indigenous peoples as they shift some of the boundaries of our current knowledge generation processes into a 'third space' to enable the equitable representation and reciprocal valorisation of plural epistemologies in the academy. Open-ended inter-epistemological dialogical processes such as this might enable indigenous learners (researchers, teachers, learners and parents) to uncover/recover indigenous knowledges and engage the modern sciences as indigenous scholars innovating at the nexus of some of the national environmental priorities of biodiversity loss and climate change. For example, the root-wrapping use of *micorrhyza* by the AmaMpondo (Xhosa) on uprooted indigenous plants to be transplanted at new sites can significantly die off due to change in soil environment for replanted indigenous species to restore biodiversity in a region of high rainfall variability. Pre-colonial climate migration and drought mitigation practices might also inform the current need for water conservation farming in a water-scarce region of high seasonal variability entering an uncertain period of climate change.

The exploratory work is engaging urban teachers, learners and parents as co-investigators and custodians of re-appropriated (re-searched) Nguni (Ndebele, Swati, Xhosa and Zulu), Sepedi-Sotho-Tswana, Venda and Tsonga indigenous knowledge practices. The critical pedagogy has participants relating their Mother Tongue knowledge-experience with curriculum science as evident in Ramasike and Ngcoza's (2017) study. Open-ended dialogical processes often open into a 'third space' of innovative knowledge co-generation consistent with the socio-cultural innovation of earlier socio-ecological adaptation amongst indigenous peoples in the Eastern Cape. For example, the expansion of traditional fermentation practices (as used in the making of *amarewu* and *umqombothi*) into the making of sourdough bread (*Isonka*) amongst rural women as part of their struggle against the marginalising intrusion of the apartheid state in the 1970s and 80s.

A process theory of learning for an integrating pedagogy

The proposed integrating dialectical pedagogy is being undertaken in Mother Tongue by learners through engagement with parents and community elders as custodians of indigenous knowledge, to generate data on indigenous knowledge practices that relate to contemporary environmental issues. These are being taken into a deliberative engagement with the science curriculum that enables contextualised epistemological access for indigenous learners and reciprocal valorisation of knowledges in formal education processes. The plural knowledge generated is being dialectically modelled to inform lesson study interventions for assessment of the extent to which participants are successfully learning science and using what they have learned in 'third space' social innovation in relation to pressing environment and sustainability concerns. For example, using *izala* (the Zulu traditional composting practice) or *ithuthu* (Xhosa composting practice) to reduce the solid waste stream through composting of local organic waste to enhance local food production or exploring insulation cooking to save electricity and money.

The critical processes of dialogical meaning-making and expansive learning are reflected in Figure 2 as an open-ended image of learning in the reflexive company of others.

Figure 2. An open process model for ESD as deliberative Action Learning
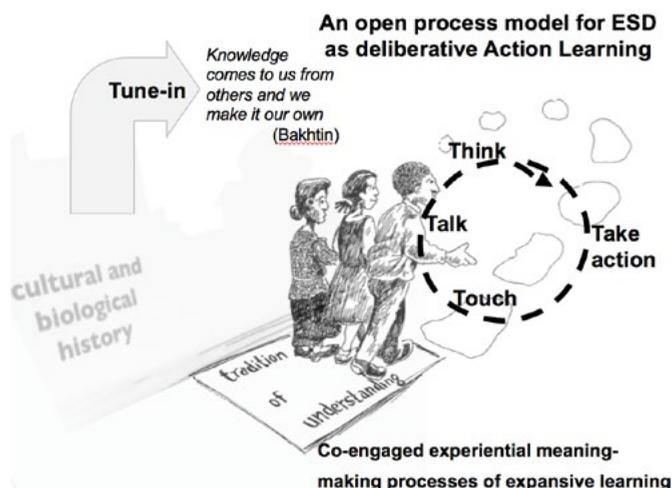
Source: Adapted from O'Donoghue (2015)

Here most knowledge comes to us from others out of cultural and biological history as we work in contexts of co-engaged meaning-making within open processes of dialogue (Talk), experiential encounters (Touch) and praxiological reflection (Think/Do). New knowledge and innovations are also generated in co-engaged learning interactions in response to emerging changes in the lived environment. In these ways, we have experiences and make meaning in continuing dialogue within open-ended processes of experiential re-semiotisation and expansive learning.

Reflecting on situated, reflexive learning processes in this open-ended way, it is possible to reframe curriculum encounters with science so that learners might pose problems and engage with the scientific knowledge from within expansive cultural practices and propositions for engaged meaning-making (re-semiotisation) with the common good in mind (Lotz-Sisitka, 2017). This curriculum process raises contradictions that might provoke learning towards explanatory insights that resonate with the social realities of the modern world and emerging risk. Here the self-activity and 'critical consciousness' perspective of Paulo Freire (1972:70–71) points to how in a problem-posing and dialogical approach to education, meaning making develops with '[p]ower to perceive critically the way they exist in the world with which and in which they find themselves'.

An open-ended conclusion towards continuing exploratory research

Through this positioning analysis, the research challenge became 'How will we approach exploratory work with indigenous partners with a re-appropriation of indigenous knowledge practices and how might this contribute to learning science with expressions of cultural agency towards a reduction of social-ecological risk and exclusion?' The assumption here is that the succession of curriculum change has not managed to resolve the problem of exclusion

of indigenous knowledges and a lack of epistemological access and relevance, so continuing curriculum change is unlikely to meet the ideal of socio-cultural inclusion. The proposed research trajectory is intended to look into processes of inclusive engagement of plural epistemologies towards enabling epistemological access for indigenous learners by exploring Mother Tongue re-appropriation of situated heritage practices that are foundational for, and that resonate with, the modern sciences in ways that invoke reciprocal knowledge valorisation and that might inform social innovation towards a sustainable future.

Endnotes

1. Pers. Com. UNISA, November 2014.
2. If one overlooks an essentialist bracketing of Xhosa within a fundamental reading that culturally inscribes them outside being modern (a common problem in modern intellectual thought), there is a useful point being made here in relation to a tension between life experience being brought to school and seen in relation to an abstracting reification of scientific ideas that confront learners in the science curriculum.

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About the contributor

Ngcoza, Kenneth Mlungisi
Education Department, Rhodes University, South Africa
k.ngcoza@ru.ac.za
Kenneth Mlungisi Ngcoza is an Associate Professor at the Education Department, Rhodes University. He has supervised a number of MEd and PhD students in Science Education. His research interests include professional development, science curriculum, indigenous knowledge systems as well as ESD.

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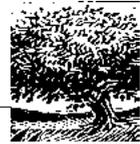
Integrating indigenous knowledge practices as context and concepts for learning of curriculum science: A methodological exploration

Caleb Mandikonza, University of the Witwatersrand, South Africa

Abstract

Teachers and learners bring tacit as well as explicit knowledge into learning contexts. In the science classroom, learners' tacit knowledge can involve sustainability practices that have been passed down for many generations and have enabled people to survive in their particular environment and derive benefit from it. This study examines an example of such a practice that was observed in a rural community. The study sought to establish whether such a sustainability practice could be incorporated into the formal science teacher training classroom with a view to expanding the teaching and learning of science curriculum concepts. The study was carried out through observation of rural participants as they conducted certain sustainability practices as well as through interviews with the participants. Student teachers preparing for lesson planning and teaching presentations (as part of their peer-teaching activities) engaged with these sustainability practices in a six-phase process. Socio-cultural approaches guided the analysis. The study showed that, through a carefully considered methodological approach, it was possible to use those practices with which learners were familiar in their daily lives – that is, their habitual indigenous knowledge practices (IKPs) – to unpack and explain related scientific concepts from the school science curriculum in the classroom (habitual practices of classroom science) (Bourdieu, 1998). The study illustrated how knowledge of science can be developed from context to concept. The study was only conducted with student teachers in a peer-teaching context, but it would be interesting to investigate how such an approach could be used by student teachers during their teaching practice as well as by teachers who teach at the secondary school level.

Introduction

The quest for quality education has been promoted by UNESCO since the Jomtien Conference (UNESCO, 1990), which called for 'Education for All'. Education quality was understood in terms of meeting everyone's basic needs. This call was followed by the Dakar Education for All Conference (UNESCO, 2000), which focused on enabling improved education practice to facilitate better epistemological access and retention in schools. This focus grew into the commitment to promote more inclusive forms of educational experiences. As education has become more inclusive in terms of numbers, gender and different communities, the concept of quality education has evolved to mean the relevance and effectiveness of what actually happens in classrooms, as proposed by the Incheon Declaration and Framework for Implementing Sustainable Development Goal (SDG) 4 (Magni, 2016).

Classroom experiences are determined by contextual factors. Learners from rural and disadvantaged communities tend to find a poor fit between their home experiences and what they learn at school. Such learners tend not to see the relevance of school curriculum

knowledge and concepts with respect to their personal and communal lives (Mandikonza, 2007). Accordingly, the call of the Incheon Declaration is to make education more inclusive.

Curriculum knowledge should valorise and integrate learners' prior knowledge that they bring from home, and use aspects of this knowledge as the starting point for enabling learners to understand the scientific concepts described in curriculum-based textbooks. In so doing, the hope is to facilitate epistemological access while simultaneously enhancing the relevance of curriculum concepts in learners' lives. Knowledge that learners bring from home may simply be experiential knowledge in the form of specific practices; however, these practices are also specific to particular communities and can therefore be described as indigenous knowledge practices (IKPs). Indigenous knowledge, according to UNESCO (Magni, 2016), encompasses knowledge and practices that are unique to particular communities, cultures or societies. In addition to practices, these knowledge systems include values, beliefs and world views. These forms of knowing often serve as the ways a community manages their concerns about environmental sustainability and, materialising at the intersectionality of human life, these forms of knowing have been maintained for many generations (Odora Hoppers, 2005). Odora Hoppers (2005) further states that users' knowledge may be either explicit or tacit. Even though indigenous knowledge is mostly specific to particular communities, there are some aspects that are common among diverse communities (Sillitoe, 2006). For example, the process of brewing traditional beer is widespread among diverse communities, with only minor variations.

This article presents an attempt to integrate IKPs concerned with sustainability into the science curriculum as a starting point for assisting pre-service or student teachers at a teacher training college to develop an understanding of scientific concepts.

Background

As the Zimbabwean economy declined, the government progressively withdrew its support for schools. Conventional resources such as textbooks became very expensive. Laboratory resources became both expensive and unavailable. Schools in rural areas have suffered the most, as learners cannot afford to pay the fees to purchase the needed resources. Only the teacher has the recommended textbook and the learners thus depend on the teacher's knowledge and notes. But all learners taking science have to work through the same national curriculum and sit for the same national examinations. The aim of this study was to enable learners to understand curriculum science concepts in ways that enable them to discover the relevance of these concepts to their lives, and to develop a view of science in the community by building on the sustainability of their IKPs (Agrawal, 1995; Le Grange, 2004). The class of student teachers in this study comprised two cultural groups of students. One group came from Zimbabwe, mostly from a Shona cultural background, while the other group was composed of Namibians, the majority of whom were of the Oshiwambo culture.

Teachers and learners bring tacit as well as explicit and conceptual knowledge into learning contexts. Educators and learners therefore possess indigenous and cognitively located knowledge, knowledge skills and knowledge practices, hereafter referred to as IKPs, which can also be tacit because these include things that they know (knowings) and things that they do

very proficiently (doings), mostly without conscious thought (Kemmis, Wilkinson, Edwards-Groves, Hardy, Grootenboer & Bristol, 2014; Mandikonza, 2007). Mudaly and Ismael (2013) recognise the embeddedness of indigenous knowledge in human experiences, the validation of which developed over many years of trial and error through varied learning processes and with the ultimate practical wisdom that is possessed and shared at different levels of society. The educators and learners would have learnt these practices as part of their lived experiences. As such, these lived experiences constitute the context as well as the prior knowledge of practical solutions to daily challenges that learners bring to class (Cole, John-Steiner, Scribner & Soubeman, 1978). Since some IKPs involve concepts that are considered scientific (Mandikonza, 2007), their integration into school learning would therefore have the potential to engender the contextual relevance of curriculum science concepts as well as a better understanding of the concepts themselves. The IKPs, therefore, constitute what Bourdieu (1998) terms the learners' and educators' 'habitus'. Accordingly, this article reports on an exploration of the potential for using these knowings and doings (habitus) to enhance leaners' understanding of classroom science.

Learners are said to understand concepts when the 'zone of proximal development' (ZPD) shifts (Cole *et al.*, 1978). Engeström and Sannino (2010), citing Davydov (1997), who in turn draws on the dialectical philosopher Illeykov (see below), assert that concepts ascend from the abstract to the concrete. That is to say, learners understand concepts in such ways that they can then generalise from them. Learners begin with aspects of the concepts they can relate to, but when they have fully understood the concepts via more concretely engaged processes, they can then relate to them at an abstract level. Abstract knowledge is, according to Barsalou (1982), context-*independent* knowledge, while more concrete knowledge is context-*dependent*.

The purpose of this investigation was to establish how selected IKPs could be used to mediate the understanding of respective and related classroom science concepts in ways that would enable pre-service teachers to understand curriculum concepts more deeply (from the abstract to the concrete) by expanding their ZPD (Cole *et al.*, 1978). The research project was conducted with trainee teachers – also referred to as pre-service teachers or student teachers – during their first year of study, and was undertaken during student teachers' peer-teaching and micro-teaching practical experiences. For students preparing to go on teaching practice, peer-teaching and micro-teaching are preparatory stages in the Methodology component of the training for science teachers. During peer-teaching, a group of four or five student teachers work together to plan what to teach. Each one takes about 15 minutes to present part of a concept to a bigger group of about 15 student teachers.

The intention was to build IKPs into the suit of knowledge practices possessed by student teachers which would influence how they achieved intended lesson outcomes during their teaching practice and maximise their ability to adapt their teaching plans in response to contextual constraints, including the unavailability of conventional science resources in schools (Wertsch, 1991). This study was not focused on the differences between indigenous and western (classroom) science knowledge, but on the potential of working with both knowledge systems in order to build a better understanding of the science concepts in the curriculum upon which learners are examined.

Theoretical framework

Socio-cultural approaches – particularly the work of Vygotsky (Cole *et al.,* 1978) – were used as lenses for the analytical process of the study. Socio-cultural theory is built on the premise that learners construct knowledge. This construction is supported by the key features of socio-cultural theory, which claim that knowledge is not just transferred to learners; rather, they actively construct knowledge using the knowledge they have gained from a knowledgeable other at various levels, usually a parent or other teachers, including knowledgeable peers. As such, learning emerges out of social interactions with referents in activity. Learning, according to Vygotsky, is the development of higher psychological functions, which he referred to as higher mental functioning (Daniels, 2008). In the literature, these psychological functions are referred to as cognition or cognitive processes.

According to Vygotsky, all learning is mediated (Daniels, 2008). Learning is therefore the outcome of a learner interacting with other people as well as with the tools provided to facilitate the learning process. Such dyadic interactions either involve a knowledgeable other or they occur between peers (Warford, 2010). A learner may interact with physical tools, artefacts or psychological tools while learning with a knowledgeable other such as a teacher (Engeström, 2001). Wertsch (1991:32), citing Vygotsky, states that the introduction of a 'psychological tool alters the entire flow and structure of mental functions. It does this by determining a new instrumental act.' The IKPs in the study represent the psychological tools and their physical artefacts, the use of which was intended to influence student teachers' learning about curriculum science and thus facilitate learning of the subject in school classrooms. Vygotsky's view is that cognitive development occurs once learning has occurred.

Learning takes place at two levels: first on the social level, which involves other people and associated mediatory artefacts (*inter-psychological*); and, second, at the individual level, where the learner processes and internalises the knowledge (*intra-psychological)* through a meaning-making or semiotic process (Wertsch, 1991). This means that individuals first experience the world through social processes where language, knowledge and experiences are culturally shared via other learners, adults, mediating tools and artefacts or a teacher. Through the socialisation process, symbols (language and prior concepts) are formed and cognitive development then becomes a process of ordering, patterning and finding connections between the symbols. This enables the development of thought and thought processes, a process Vygotsky calls internalisation. During internalisation, the externally generated and mediated experience is converted into the internal form, with the mediated experience undergoing a complex transformation process in the mind. It can therefore be said that a symbol has an indicative function externally while having a semantic and semiotic function internally. Since people are socialised differently in diverse contexts, people from different cultures are thought to have different thinking tools because they have internalised different external stimuli in their particular context. The student teachers in this study were encouraged to understand the documented practices from the perspective of their own cultural experiences before going on to relate them to the concepts and practices of the school science syllabus. The research design was intended to encourage student teachers to relate to familiar IKPs before relating these to classroom science concepts in a process of

meaning-making which used IKPs as artefacts to generate meaning in relation to school science curriculum concepts.

Further to this, cognitive development is facilitated when learners interact with each other in the process of learning and while they use new tools. In this regard, the teacher brought some IKPs into the context of learning how to teach science to student teachers, using the school science curriculum in order to introduce activities that have the potential to promote understanding of conventional science concepts. Members of the school community brought baskets for enacting the process of separating chaff from maize. These are physical tools and artefacts. Indigenous knowledge practices also involve non-physical artefacts such as language, which can be verbal or non-verbal. Language as a key meaning-making process was a symbol used in the study – student teachers wrote about the IKPs in their mother tongue and also discussed and demonstrated their understanding and familiarity with the practices with each other in their mother tongue (Hasan, 2004).

The principle of the ZPD describes the process of learning and consequent cognitive development in relation to instruction. It is defined as the difference between the functions that the learner has achieved and can do independently, and what the learner may still achieve given the support of a more knowledgeable other (Cole *et al.*, 1978; Daniels, 2008). Those functions for which the learner needs to or can gain from a knowledgeable other, are not yet fully developed. The ZPD acknowledges that different learners can achieve at different levels. It further acknowledges that different learners need different kinds of support, and different ZPDs will be distributed around a learning environment such as a classroom. To reduce the differences between the ZPDs of individual student teachers during this study, and since the ZPD develops during interactive activity, the researcher and lecturer encouraged student teachers to work collaboratively in small groups. The hope was to promote the use of distributed cognition (Daniels, 2008).

Methodology

A qualitative approach guided the interpretive case study design (Bassey, 1999; Terre Blanche, Durrheim & Painter, 2006) and enabled the researcher – through involvement and participation and by focusing on what participants said and did – to learn at first-hand about the social world under investigation. The IKPs under observation were inherent to participants' livelihoods. While working with the student teachers, the researcher collected data on classroom use of IKPs. To this end, the qualitative research process brought the researcher and research participants closer together whilst drawing attention to what ordinarily and routinely happens in educational processes (Yin, 2009). Ultimately, research-focused interactions had the potential to culminate in a greater understanding between educator-researcher and subject-learners, an understanding that could enhance the learning of concepts under investigation and of any other topic in the curriculum.

The study was interpretive because it took cognisance of rural community members' and the students' experiential knowledge whilst studying what they made of these experiences (Terre Blanche *et al.*, 2006). The study probed these people's intergenerational and sustainable ways of knowing (subjective experiences) during the teaching of science to make the learning

of science contextually relevant (relatable to views of knowledge) whilst looking at ways to promote sustainable living.

The study design had six phases. During the first phase, the researcher explored and recorded IKPs in a rural area whilst among members of that community as they went about their daily lives. The observed practices were recorded by writing down all the details of the proceedings, and some moments in the process were photographed. Members of the rural community were interviewed about each of the observed IKPs in order to get details on how and why they conducted themselves that way. The researcher observed the preparation of harvested grain for storage, which included the pounding, winnowing (*kupepeta*) and storage of grain; the making of *amahewu* (an unfermented drink); the treatment of milk (preserving fresh milk for later use and souring); the making of a fire in a traditional hut; and the preparation of the staple maize porridge (*sadza/pap*). These observations and interviews were rewritten into vignettes and, where possible, illustrations were attached.

During phase two, the vignettes were brought to class, where an elderly woman from the teacher training college community was invited to enact some of the practices, such as separating grain from chaff, making a fire and making *mahewu*. While the woman did the demonstrations, student teachers were invited to enact the same processes but as they did them at home. After the demonstrations, student teachers read through the provided vignettes and then discussed the documented IKPs in terms of their own experiences at home. Any variations in practice were then added to the vignettes.

During the third phase, student teachers worked in groups of four to conduct a curriculum audit to establish whether the IKPs described in the vignettes and then demonstrated could be related to scientific concepts in the science curriculum (the Zimbabwe Junior Certificate Science (ZJC) Syllabus). The lecturer (the researcher) analysed the syllabus content and identified scientific concepts that related to the documented IKPs. Because the researcher wanted to establish how close the student teachers would get to the identified concepts during their audit, the researcher's analysis of the science concepts was not shown to the student teachers. In the vignettes provided here, the researcher's views are in italics.

In the fourth phase, students prepared lesson plans in which they used the IKPs as alternatives to the recommended and conventional activities. Out of a class of 60 student teachers, three groups chose to work with the vignette on separating different solid substances (grain from chaff) and the related syllabus concepts. Other groups chose other vignettes. This study focuses on the progress of the three groups interested in the solids–separation vignette.

The fifth phase saw student teachers using the prepared lesson plans to teach their colleagues during peer-teaching activities. In phase six, working through focus group discussions, student teachers reflected on and reviewed the mini lessons to determine how suitable the IKP was for developing curriculum science concepts.

From the observations in the field, the IKPs were noted to have emergent structural patterns. The practices were constituted in such a manner that they followed a sequential progression, a process that may have arisen from repeated practice as users were growing up.

This paper presents my views as I observed the sustainability IKPs, which I summarised in narrative form under the subtopics 'What I saw; What I heard; and What I thought' as presented in Insert 1.

Insert 1. Vignette on researcher observations in the field

Separation of grain from chaff

What I saw

The homestead in Manesa village which I visited lies on the western side and at the base of the hill slopes of the Mutema mountain range. This mountain range runs from north to south. It was in the early afternoon when I arrived and after the usual greetings the grandmother brought out baskets (*tswanda nerusero*[C]) with maize grain in a *tswanda* [C] (deep basket) and threw some grain into the air. She then left to do other chores for about an hour. When she came back she repeated the tossing of grain. She put some maize into the *rusero* [C] (flat basket) and went on to systematically winnow with her back to the mountain and the basket and hands strategically held in the air at an angle to the body, away from her and at a distance that prevented her from intercepting the air currents. At the same time she kept her eyes, nose and clothes free from the floating chaff. The position of the *rusero* prevented the chaff from whirling around her; instead it floated away as she winnowed while maize grains fell into the *tswanda* [C]. I joined her and she taught me how to winnow gently. She teased me because this was a feminine chore and male sons-in-law were supposed to do masculine chores like constructing and repairing granaries as well as repairing livestock kraals. I had to stand in a particular position so that chaff did not go into my eyes. I had to allow a reasonable amount of grain to come out of the *rusero* [C] while shaking the *rusero* [C] slightly. We did this in turn until all the grain was finished - but I always got a lot of chaff onto my clothes and face.

What I heard

When I asked the grandmother why she had tossed grain when she did, she said she that first time she tested the strength of the breeze - early in the afternoon it was too weak. The chaff fell very close to the *tswanda* [C]. The second time she tested, the breeze was strong enough. Chaff was blown further away from the *tswanda*[C]. She was winnowing her grain to take to the grinding mill on the following day. She noted that *dutu rinowanda manheru* [C] *(breezes are stronger in the evenings)*. When I asked what would happen in the total absence of wind she took me to the family's threshing platform and showed me heaps of ash. She described these as arising from fires that were made to create *mhepo yemukwasha* [C]. On a very calm day, she would perform the same process of tossing chaff into the air. Where the chaff falls indicated the direction of the weak breeze. She made a fire at the end of the platform in the direction of the falling chaff. She sang along with the burning fire. The song challenged sons-in-law of the family, whom she named, in turn, to blow a stronger breeze so that they could use the grain to make traditional beer. She said if she calls the name of one who wants traditional beer the most, the breeze will be stronger.

What I thought

The practice of winnowing observed made use of concepts of winds that descended from the mountains in the evening. Having noticed that the breeze around midday had no particular direction but blew down the hill slopes in the afternoon, I wondered whether these winds got stronger as evening approaches. These observed air movements constitute the ascending and descending winds that are taught under 'Pressure Systems' in Physical Science section of the ZJC and O level syllabuses. The separation of grain from chaff depended on their differential densities of the grain and chaff. The fire that is used on a calm day as she described was to generate stronger winds by convection, another concept in Physical Science. In the syllabus, teachers were expected to illustrate convection currents using the chimney box with a burning candle under one chimney at one end and a smouldering splinter at the other. Separation of grain from chaff does not show details of calculating density but gives practical uses of the idea of density in everyday life. The practice can also be used as a starting point to develop the concept of density. Learners can start from their experiences with density before the theoretical concept is defined or calculated. When teachers start with the indigenous process and try to explain it, they develop the conceptual content from the vantage point of the learner. It will not be the educator bringing knowledge to the class but the educator building on the knowledge of the learner. I also thought about the way people learn in the home context.

With these observations and reflections, the vignette on the respective practice was then written up.

Vignette from the field

After students had watched the college community elder and had conducted their own demonstrations, they read the respective vignette and added to it as necessary. They then reviewed the ZJC syllabus to establish whether any science curriculum concepts related to the particular IKP. Insert 2 presents the vignette on the separation of grain from chaff (with my reflections on syllabus congruency in italics, which were not shown to student teachers).

Insert 2. Vignette on the separation of grain from chaff

Preparing the grain for storage

Grain is dried on a flat ground that is prepared by smearing the surface with cow dung *(storage of food and food crops: pest control and insect repellents- biological sciences)* and allowing the surface to dry before any grain heads (maize cobs, sorghum and millet heads) can be spread out to dry. The elderly ladies take note of the prevailing wind direction and they spread the heads to cover this side of the platform. The other side of the platform is reserved for winnowing. The harvested heads are spread on a platform to dry.

When perceived dry (elderly women test the dryness by biting on the seeds once in a while using their teeth) *(alternative test/ experimental methods)*, the heads are pounded with sticks to separate chaff from grain. Grain is separated from chaff using air currents *(pressure systems-physical science)* in a process called winnowing. As wind blows, with her back to the mountain and the *rusero* and hands strategically held in air at an angle to the body, away from her and at a distance that prevented her from disturbing the air currents, at the same time keeping her face free from the floating, the lady starts winnowing. Denser grains drop downwards *(density-physical science)* whilst air currents carry lighter chaff away. Women do most of this work.

On a calm day the breeze may be too low to carry the chaff. Elderly ladies create a stronger breeze by making a fire *(convectional currents-physical science)* on one end of the platform. They start by tossing some chaff into the air *(density- physical sciences)*. The direction where the chaff falls shows the direction of the drafts of air, showing that even on a calm day some air will be moving. They then make a fire using some of the chaff or wood at the end of the platform where the wind is blowing. As the fire burns, the ladies toss chaff into the air until a breeze strong enough to be used for winnowing is blowing, meanwhile singing and ululating. Their songs encourage their son-in-laws, naming them in turn to bring some wind. This breeze is called **mhepo yemukwasha** (son-in-law's breeze). The traditional belief is that the son-in-law who wants the mother-in-law to brew beer for him using the grain that has been winnowed generates the breeze. To continue winnowing they continue adding chaff to the fire. The fire therefore makes a weak breeze blow stronger.

Other techniques employed to separate grain from chaff include sifting *(separating substances of different densities-physical science)*. When sifting the grain is tossed up and down and is shaken side to side until the grains separate from the chaff. Unwanted substances such as stones that have the same weight as the grain seed are picked up singly by hand *(separating visibly different solid substances/solid objects of the same density-physical science)*. This is usually the last stage of the separation process before the grain is poured into a container for storage.

Activity

Now that you have observed acting out on how these processes are done;

1. What do you call this process in your own language and do you do it differently in your community?
2. Make annotated drawings to show how the same process is done in your community.
3. Which of the two, traditional and modern, do you prefer to use and what are your reasons for that choice?
4. On which syllabus (ZJC or "O"-level) and which syllabus topic (s) can you use this module for science teaching?

Students discussed these guiding questions in focus groups of ten students. Table 1 presents one of the focus groups' responses.

Table 1. Transcriptions of student discussions responses on making sense of indigenous technologies

Categories	Responses
I.	**Cultural Preference**
	Modern- faster, not dependent on weather, no air pollution, need smaller space, requires a few resources, less disappointment due to bad weather conditions
	Traditional- separates unwanted (sand, cobs) materials from useful material (Mahangu)
	Modern- save time, less effort, cheaper in terms of labour, can separate large quantities of grain in the short period of time
	Traditional- flour from pure grains, no chemicals added, it is cheap and easily prepared, to keep our cultural ways of preparing food alive
ii.	**Relevance to curriculum**
	Mixing and separation, variation (ZJC)
	ZJC & O-level- convectional currents, mixing and separating
	Separation of mixtures
	Mixing and separating the substances
	On ZJC syllabus
iii.	**Cultural similarities and differences**
	Similarities
	Same choice of large seed
	Same winnowing and threshing
	Done in the same way-beating with sticks
	Differences
	Shona people can use cattle to walk over the grain on a rock instead of threshing with sticks
	Storage in clay pot and wood ash added to seed, seed + ash also stored in a conical basket (okaanda(o)) made from bitter bush (omzimba+omusati)-okaanda plastered with anthill soil and top sealed with clay soil.
	Grain pounded to powder with mortar and pestle, not ground
	When making sour milk (*Omethe*) place calabash in sunshine for 6hrs. Shake calabash vigorously until cream is isolated- cream for cooking and adornment. At times a special root is added to fresh milk to speed up fermentation process.
	Making of *ontaku*, a traditional drink mainly meant for children. Mahangu and sorghum flour are added to boiled water are stirred until well mixed. Mixture is cooled. Mixture is diluted with cold water as the cooling continues until a point where taste of the mixture still remains. Leave to settle for a few hours or overnight, mix with ready to drink *ontaku* before drinking. Making *Omalovu*- a non-alcoholic drink. Mixture of sorghum/millet flour with cold water is allowed to settle. Decant out the water and boil the remnants until the foam produced disappears. Remove pot from heat. Pour decanted water into filter sack and pour boiled mixture over it. Keep adding water until filtrate becomes tasteless. Put filtrate in a clay pot and add millet flour after the filtrate has cooled down. Let filtrate settle for 12hrs and add a little *ontaku* or *omalovu* before consuming.
iv.	**Role of Language**
	Reverting to vernacular throughout the discussions and presentations, drawings made on the board and in group responses to enhance understanding, reference to vernacular when giving presentations- students first converse in mother tongue before translating into English, illustrations on Oshiwambo processing of sour milk + storage structures

Following this discussion, student teachers went on to design lesson plans to teach science curriculum topics using the vignettes and demonstrated IKPs. Table 2 shows an overview of the analysis of the structure of the lesson plans made by student teachers in preparation for peer-teaching. The observers were the student teachers – the 'pupils' – being taught ZJC science concepts, hence the reference to pupils in the lesson plans.

Table 2. Record of detailed lesson plan structure analysis

	Group A	Group B	Group C
Lesson Objectives stated	Define separation. Identify methods used to separate objects of different densities; they must also be able to show the process	Define separation; distinguish three types of separating methods which depend on density particle size(winnowing, sieving, hand picking); describe each of the described methods	-identify methods of separating and mixing; describe each of the methods used; show how method is applied
Content shown	-separation of objects of different densities; processes separating solid mixtures- winnowing, sieving, hand picking	Mixtures -homogeneous mixtures ;heterogeneous mixtures; Impurities in mixtures winnowing; density –maize and chaff -sieving; handpicking	-different methods of separating; sifting and picking as methods of separating objects of different densites; winnowing as method of separating solids of different densities
Activities planned	- teacher asks learners on general knowledge and pupils respond by defining separation; teacher explains the processes winnowing, hand picking, sieving, pupils listen attentively	- teacher asks pupils to define mixture and give examples of mixtures, teacher gives definition of a mixture- a physical combination of two or more pure substances In which each substance retains its own chemical identity, teacher introduces the topic of separation, teacher asks pupils why separating mixtures or substances, pupils listen attentively and respond to teacher's questions. Tr. writes methods of separating heterogeneous mixtures, explains winnowing and demonstrates winnowing, asks pupils to report their observations, explains sieving, demonstrates sieving and asks questions on hand picking	-teacher asks questions such as; what is sifting, winnowing and hand picking? Gives more detail on how these methods are used, ask pupils to come upfront to demonstrate the sifting and handpicking, ask pupils to assist in the demonstration, ask pupils to go outside, demonstrate winnowing, ask pupils to assist in the demonstration/ process, Pupils observe, ask questions, respond to questions
Use of LSM shown	- Focus on Science 1 page 26	-source of material- handout by Mr. Mandikonza	-none

During the peer-teaching, the other student teachers were participant observers. Their observations and ensuing discussions on the appropriateness of the IKPs were guided by the following questions.

1. What were the objectives of the lesson?
2. Which scientific concepts/content were illustrated in the lesson?
3. Does the lesson delivered clearly bring out the concepts intended? How could the detailed lesson plan be improved on?
4. Are there any other scientific concepts that you think could be taught using the same indigenous practices?
5. What are the advantages of using these community-based activities in teaching science over more conventional teaching approaches?

6. In your thinking, how do such activities impact on learner understanding of separating solid–solid mixtures using density and what are your reasons for saying this?
7. What constraints did you encounter when preparing for these activities, and are there any other constraints you might come across when preparing for such lessons?

Students then sat in focus discussion groups to respond to the questions. Their responses were carefully recorded and then shared with the whole class. Table 3 shows some of the focus group reflections on the lessons demonstrated. Observing students were able to relate the concepts they had been taught to the science curriculum concepts outlined in the syllabus. The responses were categorised using the discussion questions. These questions emerged out of the attempt to establish the efficacy of using an IKP to teach concepts in the science curriculum.

Table 3. Focus group responses to guiding questions on use of indigenous knowledge practices

Categories	Responses
Scientific concepts shown	-Mixing and separation
	-Separation of solids of different density, same density
Topics intended brought out	- Yes, intended concepts were clearly illustrated
Possible improvements to lesson	-It must be improved on the trs and learners activities by making it more child-centred, letting the pupils to demonstrate what they know. - can add other activities to separate objects of different densities, like separating beans and rice from chaff by immersing in water
	-Can be improved by including other concepts, eg solids of the same density
Impact on understanding of science concepts	- Pupils will understand the concept better because they feel the phenomenon of what happening Help pupil recognise easily
	It can go beyond what they know before
	It makes them to understand because they use and see this process regularly at the community when their parents even themselves are winnowing maize
Advantages of community based activities	-Availability of materials, easy to understand, relate to everyday activities that the pupils understand more
	-Yes It will improve learners' thinking capacity
	- This encourages females to do their sciences more
	-For pupils to understand and appreciate the community based activities
	- pupils can practice it at home
	- no laboratory is required
	- community members may recognise more with what is happening in class, i.e. bringing their materials to class may make them more supportive of teaching and learning of their children
	-other subjects may from science and invite members of the community more in their lessons

Disadvantages of community-based activities	- if teacher's scientific background is based on the text book the tr may not see usefulness of these practices in classroom learning
	-unfavourable weather conditions such as absence of wind may affect display
	- spoken language may be a barrier or non-Shona speakers, who may not accurately describe the processes involved since some terms are difficult to translate
	-school administration may not think that that a teacher is doing his/ her job well if a community member comes to class to demonstrate
	- parents not involved may not see these activities as necessary for learning
	- learners may think that the teacher is wasting their time as thy are taught by a community member in vernacular, as initially did the student teachers
	– Non-Shona speaking students may meet problems trying to identify parents who can lead these activities
	-In some communities in Shiwambo culture men use shovels instead of baskets and may not find it easy to use baskets when demonstrating such activities.

These results were then used to discern the findings of the study, as discussed in the next section.

Discussion on the findings

The study shows that the IKPs under review are constituted of science concepts and principles as well as sustainability principles. The winnowing process is associated with the conventional scientific principle of density; density is used to separate grain from chaff. However, the principle does not work in the absence of strong breezes or wind. Therefore, scientifically, the separation of grain from chaff is conducted in relation to the movement of wind. Wind movement is a relational experience in that it occurs during specific times of the day and can be explained in terms of pressure patterns. Wind movement can occur in relation to local–level convectional currents such as when a fire is set up at one end of the winnowing platform, or at a wider level such as when downhill breezes happen naturally during the evening. People have therefore been able to live sustainable lives by observing patterns of nature over long periods of time and then making use of them. In order to make use of these patterns, such as wind movement patterns, people have developed the appropriate skills. The ability to expertly engage in the process of winnowing is one practice that was developed in relation to wind movement. In some Oshiwambo communities in Namibia, it is the men who do the winnowing, using shovels. As they toss the grain and chaff from one place to another, wind blows away the light chaff to leave the grain. The student teachers knew how to perform these practices very well, as demonstrated by the ladies who enacted them and who seemed to enjoy showing the class what they were capable of. The study showed that it was possible to open up thinking about certain scientific concepts in classroom science (habitual practices of classroom science) (Bourdieu, 1998) through a carefully considered methodological approach using what students knew and were able to perform very well in their everyday lives, namely, their indigenous knowledge practices (indigenous habitual practices).

After observing rural community members, the researcher asked if he could try out the process of winnowing himself. Even though he was not very successful and ended up with chaff on his face, he nevertheless learnt how to handle the basket, how much of the mixture of seed and chaff he should allow to drop at a time and how to position himself in relation to the

wind direction. This process involved a knowledgeable other, the older member of the family. Since IKPs are generally performative in nature, there is usually a knowledgeable other who engages the learner in an apprenticeship process. However, some practices are limited at times to a specific gender. Cultural issues are likely to become relevant when working with IKPs, and teachers will have to be careful to choose non gender-specific practices. While the college elder was demonstrating, the female students felt comfortable when doing the activity, whereas the male students were reluctant to participate in what they saw as a female chore. Male student teachers could therefore be excluded from some forms of participation.

The demonstration by the college community member was one way of showing the role of a knowledgeable other. She knew how to demonstrate the practice for the student teachers, some of whom had not done it before but still tried it out. The student teachers who were already proficient at the process helped those who were not so skilled.

The study design entailed students working in teams to make sense of the IKP described in the vignette during a review of the syllabus and to then plan lessons with relevant IKPs. Each student chose a section of the lesson plan and presented a 15-minute section of the planned lesson that illustrated the use of an IKP. In the section that they taught, they were to show an aspect of indigenous knowledge and how it linked to science curriculum content specified in the syllabus. Student teachers supported each other at each phase of the study, but also had to each teach part of the lesson back to their peers (Warford, 2010). This process illustrates the strength of the students working at a social level in order to build individual understanding and confidence on lesson delivery (John-Steiner & Mahn, 1996). To this end, using IKPs to teach science concepts among teachers illustrated the movement from the social to the individual levels (Fernyhough, 2008). It cannot be assumed that student teachers had the same knowledge and expertise with respect to the IKPs brought to class. This was evident when male students refused to take part in the female chore of winnowing. There were also minor cultural differences in the practices, as in some Oshiwambo communities where males used shovels to toss grain into the air, but with the same result. This is an example of distributed cognition. Educators need to take note of distributed cognition and ensure that learners are at the same starting point, as provided for by the textual vignette, before introducing the next task. The syllabus review process would have been different had students not been given the chance to share their home experiences of the demonstrated practices.

The vignettes written up in the field were used as reading and reflective material to guide students to make sense of the IKPs. Student teachers were able to relate their own practices at home with the ones described in the vignettes. Vignettes were therefore used as mediation tools or artefacts to stimulate thinking about practices in their own culture while enhancing meaning-making on the relationship between the content of the vignettes and the content of the science curriculum. The IKPs described in the vignettes were symbolic artefacts or psychological tools that were brought to the class. Physical artefacts included the winnowing equipment that was brought by the college community elder. The equipment enabled student teachers to act out the practices while following the vignette descriptions.

The ZPD in this study was determined in terms of what student teachers knew about IKPs at home and how they were able to use these in planning and executing meaningful lessons.

Student teachers came to school with knowledge of certain IKPs, with some being able to conduct them expertly. They however had not been involved in the active process of analysing the science curriculum in terms of the IKPs as a starting point for teaching science concepts from the curriculum. The vignettes, demonstrations, the syllabus review and the collaboration around planning and peer-teaching were processes that were used to scaffold student teachers' experiences with IKPs in the classroom.

Conclusions

The study illustrates how knowledge of science can be developed from context to concept and, further, to expansive concept development by introducing certain IKPs that were then linked to curriculum concepts related to the separation of solid–solid mixtures. Engeström and Sannino's (2010) view of raising learners' understanding from concrete to abstract was illustrated by starting off with practices that students engage in as part of their daily experiences and then extending these to the more abstract conceptual and conventional science concepts involved in the separation of solids in a mixture as they are covered in the curriculum. According to Illyenkov (in Lotz, 2019), science knowledge is abstracted in language (emerging from historical socio-material interactions) until it is experienced and practised in a new setting. Once experienced and practised, it can then be understood as a concrete concept which can then be further abstracted or generalised in more meaningful ways, hence Illyenkov's insight that concepts are formed 'in spiralling abstract and concrete moments of thought in our activity in the material world' (Lotz, 2019:11). Accordingly, the separation of solids is an abstract notion in the language that describes separating mixtures. The practice and process of separating grain from chaff provided a material example and experience of the process of separating solids. It is after experiencing the process of separating grain from chaff that student teachers could develop a more concrete concept of the separation of mixtures. This new understanding is the more meaningful requirement of the school science curriculum, where learners are expected to show their understanding of separating various forms of mixtures. Through the concrete experience, students were better able to access more abstract science concepts and to relate them to other such science concepts in a spiralling and relational way. Via this spiralling and relational process of abstract–concrete encounters, students could relate the process of separation to such notions as density, size and the characteristics of individual constituents of mixtures. The approach used in this study points to the quality education demanded in various international agreements on education, including SDG 4. This is education in which learners can recognise and relate to the knowledge being taught, which is a positive step towards engendering the relevance of education. In so doing, science teaching is not divorced from society, and contributes towards the development of science *in* society as well as science *for* society.

The study pointed to the potential of IKPs that involve sustainability for expanding the teaching of curriculum science concepts and, more specifically, for peer-teaching activities in a teacher training college context. The method of starting off with observations in the field and documenting IKPs before sharing them with student teachers seemed to facilitate

better understanding of the practices. The use of mediating tools such as written materials that in themselves mediated understanding of the practices (which was consolidated by giving student teachers an opportunity to enact the practices using physical tools) seemed to enhance understanding of the practices, which were then used to review the relationship between these practices and syllabus concepts. Once the relationship with syllabus concepts was established, it was much easier for student teachers to design lesson plans that integrated the two forms of knowledge. The study was only conducted with student teachers at teacher training college who demonstrated this potential, but it would be interesting to investigate how such an approach could be used by student teachers during teaching practice as well as by teachers working in schools with secondary school learners.

The study demonstrated elements of catalytic validity (Lather, 1986) as student teachers show interest and enjoyment during the process of teaching science concepts from the viewpoint of IKPs. It is hoped that this positive attitude towards using IKPs in the teaching of science concepts will be carried through into their science classrooms with actual learners.

Notes on the contributor

Mandikonza, Caleb | School of Education, University of the Witwatersrand, South Africa
ORCID: 000-0002-5530-0655 | caleb.mandikonza@wits.ac.za
Dr Caleb Mandikonza's research interests lie in pre-service science teacher development, teacher academic professional development in the fields of environment and sustainability education, and in indigenous knowledge practices, which he views as providing the backbone of knowledge–skills when conventional classroom knowledge is first encountered.

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Shared commitments towards social resilience in populations vulnerable to extreme weather conditions

Ana Lucía Maldonado-González, Gloria Elena Cruz-Sánchez, Laura Odila Bello-Benavides and Edgar Javier González-Gaudiano, Universidad Verarcruzana, Mexico

Abstract

The processes involved in moving from vulnerability to resilience imply shared commitments between community and social actors. This paper documents such a shared experience among groups of high school learners from three cities in Veracruz state, Mexico, which have been periodically affected by extreme weather conditions. Earlier research carried out with high school learners and teachers analysed the resilience that the community demonstrated while coping with, and recovering from, an environmental contingency. In this initial research stage, we obtained information from official sources, and from questionnaires and interviews on the physical and social elements that impact the learners' vulnerability. In addition, we identified the participants' interest in being involved in processes to build resilient communities. With all this information, it was then possible to make progress in the development of strategies towards building the relevant capacities in those high school learners interested in becoming change agents in their own communities. The research also contributed to the creation of intra-community contingency support networks in the three municipalities participating in the study. In addition, high school learners and teachers became interested in initiating environmental protection activities and in taking on the commitment to communicate their concerns to decision-makers in their own communities to try and influence public policy. Accordingly, these actions and shared commitments can be seen to foster community and social resilience.

Key words: environmental education, climate change, vulnerability, social resilience.

Resumen

Los procesos para transitar de la vulnerabilidad a la resiliencia implican compromisos compartidos entre comunidad y actores sociales. Este artículo muestra la experiencia participativa con población joven, alumnos de bachillerato, de tres municipios del estado de Veracruz, México, periódicamente afectados por fenómenos hidrometeorológicos extremos. Se realizó con anterioridad una investigación con alumnos y docentes de bachillerato, relacionada con la resiliencia comunitaria que ellos gestionan para sobrellevar y recuperarse de una contingencia ambiental. En estas etapas iniciales de la investigación, se obtuvo información de fuentes oficiales, cuestionarios y entrevistas, sobre elementos físicos y sociales que propician su vulnerabilidad. Además identificamos el interés de los participantes por involucrarse en procesos para crear comunidades resilientes. Con esta información, fue entonces posible avanzar en el desarrollo de estrategias orientadas a la formación de capacidades en los alumnos de estos bachilleratos interesados en convertirse en agentes de cambio de sus propias comunidades. También se favoreció la creación de redes intracomunitarias de apoyo ante contingencias para los tres municipios participantes en el estudio. Asimismo, emergió el interés en los

alumnos y docentes por detonar acciones de protección y defensa ambiental, asumir el compromiso para transmitir estas preocupaciones a tomadores de decisiones en sus propias comunidades y buscar así incidir en la política pública. Se trata entonces de acciones y compromisos compartidos que pueden ser detonantes de resiliencia comunitaria y social.

Palabras clave: educación ambiental, cambio climático, vulnerabilidad, resiliencia social.

Introduction

Coastal populations are periodically affected by extreme weather conditions, which have gained in frequency and intensity in recent years. Geographical location is by itself a risk factor. These coastline zones are areas where climate change manifests more intensely. The coastline of the state of Veracruz, situated in the Gulf of Mexico, is 720 kilometres long. Many of the more than 7 million inhabitants live in the low areas of river basins adjacent to rapid response rivers. Besides this, urban growth has taken place in high-risk areas, where living conditions are precarious and there is little or no public service delivery or infrastructure. All this contributes to physical and social vulnerability and aggravates the population's conditions when facing a climate contingency. This has been the case in the study localities, which belong to the municipalities of La Antigua, Tlacotalpan and Cotaxtla, in the state of Veracruz.

This introduction is concerned with the conceptualisations of vulnerability and resilience that support the research. We will then go on to focus with more emphasis on everything related to the processes that can contribute to social and community resilience, since this resilience is embedded in the current stage of the research being conducted in these localities.

Vulnerability is associated with ecosystemic depletion, as well as with the loss or weakening of social well-being caused by environmental and social threats. Vulnerability can be studied as a pre-existing condition in a person or in a community. It can also be studied as a social product and process mediated by governmental economic and social decisions (Adger, 2000; Aguirre, 2004). Specifically, social vulnerability is defined as a community's exposure to stress following a disturbing event which has altered their means and conditions of life (Adger, 1999).

In our research, we adhere to Anderson and Woodrow's (1989) typology of vulnerability: 1) physical vulnerability (climate, location, ground, housing, public health service and education infrastructures, and productive activities of a locality); 2) social vulnerability (institutions, political system, demographics, decision-making processes and socioeconomic activities); and 3) motivational–attitudinal vulnerability (a community's self-image in terms of the skills and knowledge available to deal with a given risk and its actual occurrence).

Within this context, the approaches towards studying a community's vulnerability to a threat, and the threat's potential impact, tend to focus on: 1) vulnerability as a state of the community, where the focus is on inquiring about the economic, social, cultural and political situations which make it vulnerable (social and motivational–attitudinal vulnerability elements); 2) vulnerability as a component of the community, where the geophysical and climate conditions which make the community vulnerable are considered (i.e. the proximity to rapid response water bodies), as well as the cultural, social or economic resources the

community are able to mobilise in order to face and overcome such vulnerability. Hence, vulnerability is not seen as an immutable state but one that can be transformed (Anderson & Woodrow, 1989).

In epistemic congruence with this perspective on vulnerability, the risks are a stress factor for a broad sector, or all, of the community. This stress factor is the by-product of a potential threat, which could be economic, political, social or environmental (Barber, 2013). Risk is quantified using indicators, or scales, that determine the risk's probable impact in terms of the physical damage resulting from the magnitude of the threat and the degree to which the community is exposed to it (González Gaudiano & Maldonado González, 2017).

Specifically, the risks associated with climate events are valued as one more fact of community life, mediated by political, social, economic, cultural, geographic and physical realities. It is important to understand the processes through which communities use all kinds of resources, and through which they adapt and transform their environment, as they face those climate change-related phenomena affecting their vulnerability (Adger, 1999).

Community and social resilience have been defined in several ways. Community resilience is viewed as the capacity for recovery and growth (Agani, Agani & Landau, 2010) which allows the community to adapt to new conditions (Cheshire, Esparcia & Shucksmith, 2015). From a different view point, social resilience is understood as the capacity for dealing with disruption (Adger, 2000), as well as the capacity for energising advantageous relationships during the recovery from the stress of a given risk (Cacciopo, Reis & Zautra, 2011).

These conceptualisations originate from various approaches, depending on the particular response to the risk in question: 1) resist or compensate – the most basic form of response; 2) protect and recover – where the presence of risk is recognised; and 3) transform – the deepest and most complex form of resilience in response to multiple causes of risk (Adger, 1999, 2000; Kais & Islam, 2016). Social resilience favours and energises, among its main components, the relationships of power and politics among the various social actors involved in the community managing the risks and vulnerability, such as government agents and economic, academic and social entities (Keck & Sakdapolrak, 2013).

Other approaches consider resilience as: 1) an aspect of individual subjects or communities, or 2) as a process in which protective and risk factors interact (Ahren, 2006). The first approach here has been subject to multiple criticisms related to its conceptualisation of resilience as an aspect or characteristic of people or communities, as an attribute that is possessed or not, instead of as a dynamic process developed throughout life where the aforementioned factors interact, and which are possible to manage. Hence the importance of clarifying this condition (Earvolino-Ramírez, 2007). Another criticism of the first approach is related to its specific and temporary dimension, pointing to the need to delimit the set of protection factors that are energised when a community is faced with specific risk factors, within a given time period, and when mediated by social and contextual conditions (Fergus & Zimmerman, 2005). In this regard, critics point out the importance of defining the protection and risk factors which unfold under the specific and dynamic character of resilience being researched, with the objective of avoiding generalisations and ambiguities regarding the phenomenon (Kais & Islam, 2016).

From this perspective of vulnerability and resilience, a community is characterised by its complexity, dynamism and network of relations among those who are part of it (Cheshire *et al.*, 2015; IFRC, 2014). Its members, besides sharing exposure to the same threats and risks because of their own vulnerability, share elements that give them membership and identity. These elements, according to Kais and Islam (2016) can be of three types: 1) compositional, meaning the set of physical, social, economic and cultural characteristics and resources of a community; 2) contextual, including the geographic and climatic conditions of the environment; and 3) functional, considering the mechanisms a community manages in order to coexist, such as the actions and processes deployed to respond to risks, for example the floods these populations face every hurricane season.

Conceptualisations which consider this view of community and risks derived from climate change come from the approach to resilience as a dynamic long-term process of interaction between risk and protection factors against a hydrometeorological phenomenon. They define community resilience as the capacity acquired and fostered from community processes to face these phenomena, recover and reduce their impact, and to adapt and establish, through self-organisation, new community conditions which reduce the social vulnerability derived from such phenomena (Cheshire *et al.*, 2015; Kais & Islam, 2016; Landau, 2010). This capacity depends, as pointed out by Landau (2010), on the resources the community possesses, its degree of social vulnerability and the level of networking among its members in terms of trust and reciprocity, as well as on recognising the uncertainty which characterises these phenomena and influences the community's social vulnerability and its level of self-organisation (IFRC, 2014).

In the first stage of this research, the aim was to identify community resilience. In the second stage, detailed in this article, the objective was to progress towards social resilience in a collaborative manner, that is, is to tackle social vulnerability against extreme weather conditions, which is intrinsically dynamic due to the uncertainty of the phenomena and the conditions of a community (Keck & Sakdapolrak, 2013). Social resilience takes cognisance of power and political roles, members' participation levels in the transformation, social relationships and the network structure within the uncertainty. Thus, social resilience is understood as the capacity of a community's members and social actors (government, institutions, etc.) to manage economic, material, social and cultural capitals that allow them not only to face and adapt to adverse situations but also to generate favourable environments that reduce a community's social vulnerability within its participation networks and its power and political roles (Kais & Islam, 2016; Keck & Sakdapolrak, 2013).

In studies on community and social resilience to extreme weather conditions (Cheshire *et al.*, 2015; González Gaudiano & Maldonado González, 2017; González Gaudiano, Maldonado González & Sánchez Cruz, 2018; IFRC, 2014; Kais & Islam, 2016; Maguire & Cartwright, 2008), one of the main aspects is the recognition of the community's capacity for reacting to and facing these events collectively, both in terms of decision-making and acting from the capacities it already possesses as well as in terms of the prevailing economic, social, political and institutional dimensions.

Context of the study and a brief synthesis of its initial stage

The municipalities of La Antigua, Tlacotalpan and Cotaxtla are located in the centre of Veracruz state, Mexico, in the river beds of the La Antigua, Papaloapan and Jamapa rivers, respectively. These are areas of warm sub–humid weather with summer rains, and which are constantly affected by extreme weather conditions (cyclones and tropical storms). These phenomena have led to floods in the places studied. Table 1 presents their most relevant geographic and demographic characteristics.

Table 1. Geographic and demographic characteristics of the study communities

Municipality data	La Antigua	Tlacotalpan	Cotaxtla
Locality	José Cardel	Tlacotalpan	Cotaxtla
Population	19 902 inhabitants (urban)	7 600 inhabitants (semi–urban)	1 167 inhabitants (rural)
Temperature range	24–26°C	24–28°C	24–26°C
Rainfall range	1100–1300 mm	1400–2100 mm	1100–1300 mm
Altitude above sea level	10–100 m	5–10 m	10–200 m
Land use	Agriculture (34%) Urban area (3%)	Agriculture (21%) Urban area (1%)	Agriculture (38%)
Vegetation	Pastureland (34%), jungle (15%), other (11%)	Pastureland (66%), reed bed (7%)	Pastureland (55%), jungle (7%)

Source: Gobierno del Estado de Veracruz (2015a, 2015b, 2015c)

In its initial stage, this study's purpose was to get to know the vulnerability and possible community resilience, identified by high school learners, to extreme weather conditions; and from this, to generate strategies which could contribute to strengthening the capacity for increasing community and social resilience.

High school learners aged between 15 and 18 participated in the study. This is a population sector distinguished by a willingness to participate in this kind of activity and to give information, both for the questionnaire applied in the first stage of the research and during the workshops of the second stage. Moreover, this group shows enthusiasm for getting involved in rescue work when confronted with extreme weather conditions. For this reason, young people are potential agents of change, as demonstrated in the first opportunity presented by an earthquake.[1]

This initial stage of the research consisted in administering a questionnaire for the purpose of gathering information on the community's vulnerability and resilience. A research survey on the physical risks these communities face when coping with floods was also carried out. In addition, semi-structured interviews with key local actors (high school principals, mayors, and civil protection and health services personnel) were conducted with the objective of triangulating the information obtained from the learners and adding depth to the data related to vulnerability and resilience. The main results of this stage have already been published. Therefore, due to limited space, we will not deal with them in any detail here (González Gaudiano & Maldonado González, 2017; González Gaudiano *et al.*, 2018).

Development of a collaborative research project: Towards social resilience

The second stage of the research, which will be discussed in detail here, consisted of a series of sensitisation and training activities in each locality, as well as additional activities conducted at the Universidad Veracruzana, Xalapa Campus. For this stage, high school principals in the study area were contacted in order to jointly coordinate a series of workshops aimed firstly at high school learners and later at teachers. The goal of these workshops was to introduce certain environmental topics into high schools which contributed to the collaborative acknowledgement of local problems and their possible solutions, whereby the learners worked in teams and presented their contributions. It is worth mentioning that the discussion topics were derived from the diagnoses made in the first stage of the research. Climate change was selected as the main topic because of its impact on these localities as a consequence of their geographical location. The people in these communities acknowledge the reality of climate change in the increasingly intense storms and flooding in Tlacotalpan (90%), Cardel (61%) and Cotaxtla (51%), but also in the droughts, especially in Cotaxtla (81%), and in the extreme heat waves (60% average), which have aggravated virus-borne diseases such as zika, chikungunya and dengue, according to key informants. In all these instances, high school learners recognise problems arising for their health and for local ecosystems and, from here, their vulnerability and the consequent possibilities for social and community resilience. Social acknowledgment of a problem is the first step to collective action against it, and this understanding was identified in the first two stages of the workshops, with the participation of high school learners and teachers from these localities.

The workshops were facilitated by university professors, expert researchers in climate change, health and the environment as well as by representatives of several government agencies in the fields of environment, civil protection and health. The researchers conducting this study were also involved throughout the whole process. The workshop topics and their purposes are detailed in Table 2 and 3.

During these first two participatory workshops, carried out in-situ, the youngsters reflected on climate change, its causes, consequences and possible adaptative behaviours and disaster-relief actions. Risks, vulnerability and community resilience were also discussed. In their interventions, it is possible to detect prior learning, from their school education as well as from their own experience of Hurricane Karl and of other topics dealt with during the workshops.

Table 2. First round of workshops (February to May 2016): Introduction to the topics

Topic	Purpose
Psychological impact of floods	Know and understand the implications in psychological terms of those who were affected by floods, as well as their individual and collective management.
Response to climatic contingencies	Understand how humans react and face risk-filled situations.
Climate change	Identify the causes and consequences of climate change locally and globally.
Climate change and health	Know the health implications of climate change and how to act on them.
Perception and prevention of the risks in populations vulnerable to climate change	Know and discuss perceptions of the risks and individual and collective preventive actions.
School projects related to the environment and sustainability	Offer ideas regarding projects about the environment and sustainability that could be developed in their school and locality. Based on the Green Kit Manual of BID.[2]

Note: A total of approximately 250 high school learners, divided into seven groups, participated in the workshops.

Table 3. Second round of workshops (February to April 2017): Afterthoughts

Topic	Purpose
Flood-risk prevention programmes	Present and discuss the relevance and importance of flood-risk prevention programmes and their influence on high school learners in these localities.
Consumption and ecological footprint; my lifestyle's impact on the planet	Sensitise and consider consumption and ecological footprint, as well as the impact of people's lifestyles on the planet.
Environmental conservancy and quality of life	Think about and generate action proposals for environmental conservation and how it relates to the quality of human life.
Audio-visual memory	Presentation on audio-visual memory, its importance in the study localities and how it relates to high school learners.
Climate change	Through a game-like experience, understand the local consequences of climate change and how to generate responsive actions, both individual and collective.
The high school teacher as a promoter of social resilience	Think about teachers' work related to promoting and managing social resilience. In addition, discuss some lines of action.
Climate change in high school subjects	Know the syllabus areas where climate change is included and how they can be used.

Note: A total of approximately 150 high school learners, divided into seven groups, participated in the workshops.

Some of the learners' comments are provided below.[3]

[Climate change] is something that happens because of pollution, and the effects society is provoking, it is the accumulation of harmful effects for the earth, and they manifest through disasters, rains, aggressive changes, that affects us and affects the earth.

Unbearable heat, the rivers are drying, trees are disappearing, heat is getting stronger, more intense.

We also have the different diseases that happen because of these climate changes, such as breathing diseases, where there is the cold, allergies, coughing, among others. Also, the year it happened, if you realise, was the year that 'canicula' *[mid-summer]* lasted the longest and, there were new diseases like zika and chikungunya, also where there are too many storms, where there is intense heat.

Normally, in this city of Cardel, you never heard of storms, hurricanes or even extreme heat waves, but what is happening now is something new, because this was not an area where hurricanes or things like that entered, and, since a short time ago all these phenomenons are happening and climate change gets worse every day.

All the effects *[of climate change]* are linked; for example, the economic affects the social, because, for the same thing, some people lose their jobs, and, without jobs there is no sustainability in the family, which causes extreme poverty.

Figure 1. Participation of high school learners in workshops

After conducting these workshops with school groups in each locality, smaller groups from each (34 pupils in total), accompanied by teachers (five in total), were invited to participate in further workshops over three days on the Xalapa Campus, Universidad Veracruzana. Many of the high school learners who attended had never been outside their localities. For this reason, the experience helped increase their motivation to pursue their studies, since there are either no higher education institutions in their localities or the higher education programmes that are available are limited. This comprised the third round of the workshops. Table 4 details the activities that were carried out.

Table 4. Third round of workshops (June 2017): Collaborative commitment among high school learners, teachers and social actors

Topic	Purpose
Risk communication	Approaches for communicating effectively in situations of high stress or community risk.
What is climate change?	Understand the phenomenon, its causes and consequences. Reflect on the implications of climate change in my community.
Disasters: debate	Analyse, through examples presented in video clips and their own testimony, how disasters are generated, their anthropogenic impact, characteristics and consequences.
Vulnerability and resilience	
Food and agriculture around the world	Reflect on eating and food consumption styles and their relationship to climate change.
Community	Analyse the importance of bonds within a community for facing vulnerability and acting together against floods.
Disaster prevention family plan	In teams, develop a disaster prevention plan and discuss it with the group.
Management of social resilience	Reflect on how social resilience can be fostered during climate-change events.
Development of a risk map in their community	Develop a risk map of their communities and discuss the preventive actions they can create as a group.
Youth brigade presentation. High school learners from Cardel, La Antigua	Get to know the experience of a group of high school learners setting up, and working as, a youth brigade.
Participating government actors in workshops	
SEDEMA[4]	Get to know the activities undertaken by these agencies regarding floods, and form links for future cooperation and communication.
Civil Protection	
SESVER[5]	

Note: Thirty-four high school learners and five teachers participated in the workshops.

This third round of workshops permitted a longer training programme for smaller groups of learners from each community, with the objective of increasing their participation in community brigades when next faced with a serious contingency. The rainy season of September 2017 once more caused significant damage in these places. For this reason, we visited them to find out how the learners had behaved during the emergency. There is not enough space here to narrate their complete experiences, which will be detailed in another paper. At this stage, we share the comments of some of the high school learners who participated actively in the preventive brigades in their communities:

> What we did, at the end of the workshop was to continue all of us and we created a group called JOVECO, which means 'young ecologists' [Jóvenes Ecologistas *in Spanish*]. Then the group gathered on different occasions to visit different communities that were the most affected, to help ... *(High school learners in Tlacotalpan)*

> We had to deal with resilience and adaptation, and we talked to other people in the community about the precautions for floods and earthquakes. We cannot prevent them, but we can talk about prevention and we talked to them, taught them, tried to make them understand. *(High school learners in Cardel)*

> When we returned, we started with talks for our classmates who had finished the sixth semester. It was only them at the beginning. After, we organised ourselves, some others had holidays and so. And then, we returned and everyone in the school knew we had been. We talked about the workshop, how they treated us and all that... and later there was the workshop for all the school. We gave them the talk and asked them to do activities ... We talked to them about how climate change affected the actions we can do to reduce pollution, how we can act in the face of a flood ... Besides, we placed signs in that building about the measures of earthquakes or floods ... We also explained the importance of the risk map, the evacuation routes, how far the river goes, in case it overflows and, well, they participated ... we divided them into teams and each team made their risk map. *(High school learners from Cotaxtla)*

Figure 2. Preventive signs and risk maps made by the youngsters at the workshops
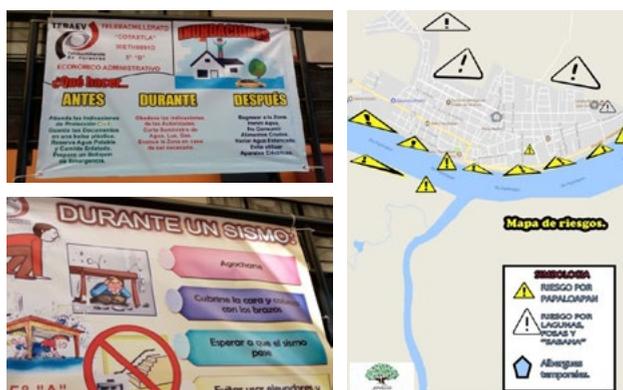
The workshops did not aim to provide solutions for the communities; their purpose was to provide information; allow collaborative reflection on their local problems and possible ways to respond to them; and to energise actions oriented towards encouraging youth and other actors' to participate in strengthening social resilience. In particular, the third round of workshops, because they were more intensive and directed, left the youngsters with an interest in setting up intra- and inter-community networks of support against climate contingencies. For this, they had to muster support from various government offices and follow up on measures that could reduce vulnerability and increase social resilience. This collaborative research aimed to promote in high school learners the capacity for organising and managing alternative ways of reducing vulnerability.

Final thoughts

The research preceding the workshops, carried out with high school learners and different social actors, enabled the researchers to understand and analyse information related to the vulnerability and resilience they identify in their own localities as well as their potential interest in getting involved by organising brigades to face any future contingencies caused by floods and thereby becoming change agents (González Gaudiano & Maldonado González, 2017; González Gaudiano *et al.*, 2018).

The localities in the study were severely damaged by a flood in 2010 caused by Hurricane Karl. The high school learners who participated in this study are currently between the ages of 15 and 18, which means they were children at the time of the floods. However, what happened is still present in their minds, as was noticed during the first exchanges with them when it was possible to hear emotional, shaky voices and witness tears as they remembered the devastating event. In this first stage of the research, the identification of the high school learners' vulnerability and resilience was one of the targets and, from there, set the course for the final stages of the study. It was discovered that, in all three localities, the community managed to overcome the disaster and move forward despite their physical and social conditions of vulnerability.

The motivational–attitudinal vulnerability related to the community's pre-existing or potential self-image, abilities and knowledge when facing a risk was not identified among the high school learners during the first stage of the research. Despite recognising the absence of opportunities for getting involved as change agents and the majority's stating that they interact little or never with different social actors (municipal authorities, civil society organisations, neighbouring communities, health services and civil protection units), most of the high school learners were motivated to participate in various preventive activities that could help reduce the community's exposure to disaster. Some of these activities involve 1) organising and participating in brigades to train the community in preventive measures; 2) making diagnoses and developing action plans in cases of emergency; 3) participating in informative and preventive community assemblies; and 4) joining reconstruction processes should a disaster happen.

These findings led to the next collaborative stage of the research, namely the sensitisation and training activities presented above.

During this stage, the interest was in advancing the collaborative process and looking for social resilience, giving privilege to power relationships within the community itself and allowing them to move towards actually managing the *risk* rather than simply managing the *disaster*. Risk management implies involving all social actors in modifying together the conditions that contribute to the physical and social vulnerability of the community. Involving high school learners in the management of risk, as change agents, can lead to collaborative processes between actors from different sectors.

The sensitisation and training activities in each locality fostered the youngsters' interest in getting involved in the different activities that had been presented by the participating government actors. These activities were mainly oriented towards protective measures concerning human health and the environment. Additionally, they included civil protection activities via preparatory training so that youngsters could then be counted on should a contingency happen. A pact was made between the high school learners and the other participating actors – and it will be important to follow up on this. As a result, there was an improvement in the management and strengthening of communication networks – one of the key elements of social resilience.

Channels of communication have now been opened between the research team and the high school teachers and learners of these localities. Before the rainy season of 2017, the high school learners visited junior schools to teach them how to deal with climate-change risks. They talked to the local authorities about prevention and, during the flood season, provided direct help to the population.

Social resilience prioritises the political dimension of a community in terms of being oriented towards the engaged action of community members and towards the actions of other stakeholders whose roles cover the management of social vulnerability and the risk caused by the event in question (in this case, extreme weather conditions). Moving from community resilience to social resilience against extreme weather conditions implies setting up processes where such a dimension is energised among the members of the community and other social actors involved in official decision-making and in the gathering of knowledge related to this risk, thus boosting collaborative action networks. This process is ongoing.

Endnotes

1.   On 19 September 2017, an earthquake severely affected several states in Mexico. In Mexico City, young people participated actively in the immediate activities of removing debris and mobilising help via social networks.
2.   http://www.iadb.org/temas/educacion/cambio-climatico/kit-verde-escolar.18688.html
3.   The comments were made in Spanish and have been closely translated by the authors. This includes the learners' comments on page 10.
4.   Secretariat of the Environment, Veracruz.
5.   Secretariat of Health, Veracruz.

About the contributors and their contributions

Lead author

Maldonado–González, Ana Lucía |

Instituto de Investigaciones en Educación, Universidad Veracruzana, Mexico |

ORCID 0000-0002-7780-8206 | anmaldonado@uv.mx

Ana Lucía Maldonado González is Professor–Researcher at the Institute of Educational Research, at the Universidad Veracruzana, Mexico. Her research topics include environmental education, climate change, vulnerability and social resilience, environmental communication and social representations.

Co-author

Cruz–Sánchez, Gloria Elena |

Instituto de Investigaciones en Educación, Universidad Veracruzana, Mexico |

ORCID 0000-0002-9394-9447 | gcruz@uv.mx

Gloria Elena Cruz–Sánchez has a PhD in Education. She is currently director of the Institute of Educational Research of the Universidad Veracruzana, Mexico, and a member of the National System of Researchers (SNI). Her line of research falls within the field of environmental education. She is a lecturer of the Master's and Doctorate programmes in Educational Research of the same university.

Co-author

Bello–Benavides, Laura Odila |

Instituto de Investigaciones en Educación, Universidad Veracruzana, Mexico |

ORCID 0000-0002-8261-588X | labello@uv.mx

Laura Odila Bello–Benavides has a PhD in Educational Research, and is an academic at the Institute of Educational Research, Universidad Veracruzana, Mexico, and a member of the National System of Researchers (SNI). Her line of research falls within the field of Environmental Education. She has authored and co-authored a number of publications related to environmental education.

Co-author

González–Gaudiano, Edgar Javier |

Instituto de Investigaciones en Educación, Universidad Veracruzana, Mexico |

ORCID 0000-0002-2161-2917 | edgagonzalez@uv.mx

Edgar J. González Gaudiano is a Senior Research Fellow at the Institute of Educational Research at the Universidad Veracruzana, Mexico, where he leads the research in environmental education for sustainability. His current research focus is on social representations of climate change, vulnerability, risk and social resilience.

Percentage contributions

During the different stages of researching and writing this paper, the authors collaborated equally on its: 1) conception and design, theory and key argument; 2) data collection; 3) analysis and interpretation; 4) drafting; and 5) critical review.

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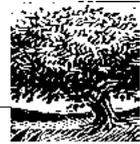
Viewpoint: Towards an IK–SCIE integrative model: A theoretical reflection on the agricultural college curriculum in Zimbabwe

Christopher Ndlovu, Angela James and Nadaraj Govender,
University of KwaZulu-Natal, South Africa

Abstract

Investment in agricultural training in Zimbabwe occurs against a backdrop of scarce resources. Therefore, an insight into the suitability and quality of the curriculum in agricultural colleges will benefit students, their communities and the nation at large. The curriculum is a key determinant of the quality of agricultural training. Researchers have argued that the curriculum in the agricultural colleges is largely based on the scientific knowledge system, representing the western worldview. Furthermore, this curriculum neither recognises the variations among the people with regard to their knowledge of agricultural practices, nor does it consider the different worldviews that students bring into the classrooms. Relevance in agriculture, like in any science subject, encourages students to participate in classroom processes more deeply, learning in their own ways and bringing together their ideas, interests and experiences. The incorporation of cultural practices into learning also facilitates environmental sustainability. This study explores several curriculum models to explore these claims and suggests an integrative indigenous knowledge–science (IK-SCIE) model that can be used in crafting a curriculum relevant for the contextual setting of Zimbabwe. Based on this theoretical reflection, it is recommended that if indigenous knowledge is integrated in the agricultural curriculum, more research on indigenous practices would be promoted, leading to acceptance, documentation and the possible integration of these indigenous practices, hence making them accessible to a larger readership.

Key words: agricultural training, curriculum, integrative model, indigenous knowledge, sustainability, integration and worldview.

Introduction

Agriculture forms the backbone of Zimbabwe's aspirations for economic development. It is not surprising, therefore, that Zimbabwe has invested heavily in agricultural training. This investment, however, has not translated into a visible proportional increase in agricultural production. In fact, agricultural production has been on a gradual decline since independence. Despite this continued decline, the curriculum has continued to reflect the western scientific knowledge systems and values whose relevance to the Zimbabwean context is debatable. The curriculum is the key determinant of the quality of agricultural training. Scholars like Mugwisi (2017) and Machingura and Mutemeri (2004) have argued that the curriculum that pertains to the agricultural colleges in Zimbabwe is largely based on the scientific knowledge system, representing the western worldview. Using the assertions of Emeagwali & Dei (2014), Higgs (2016), and Msila and Gumbo (2016), they further claim that the agricultural college

curriculum neither recognises the variations among the learners with regard to their knowledge of agricultural practices, nor the different worldviews that learners bring to the classrooms. Thus, it is imperative that a new relevant curriculum be developed that centralises and is informed by Zimbabwe's socio-economic and cultural needs and yet integrates some of the western scientific values to increase agricultural sustainability in the rural communities that are targeted by the agricultural colleges. Therefore, the purpose of this curriculum reflection is to create a pool of models from which one can extract appropriate dimensions to infuse and integrate into an eclectic curriculum development model that is consistent with the interpretivist perceptions of indigenous knowledge (IK) that can be used to develop an integrative agricultural college curriculum in Zimbabwe.

Curriculum models

The field of curriculum development boasts a host of successful curriculum models stretching from the early theorists such as Franklin Bobbitt (1924) to Ralph Tyler`s (1949) seminal work on curriculum development. Curriculum models help curriculum designers to systematically and transparently map out the rationale for the use of particular teaching, learning and assessment approaches (O'Neil & Murphy, 2010). At the same time, it should be acknowledged that although curriculum development models are 'technically useful, they often overlook the human aspect such as the personal attitudes, feelings, values involved in curriculum making' (Ornstein & Hunkins, 2009:15). Therefore, models presented in this study are analysed and the best practices for enhancing student learning are infused in the proposed eclectic curriculum development model. The study focuses mainly on the contributions of Tyler, Hilda Taba, Lawton and Stufflebeam as well as on Mthunzi's negotiated entrepreneurial curriculum.

Tyler's curriculum model

Ralph Tyler's (1949) curriculum model is typical of a product curriculum model. It is deductive in nature and primarily focuses on the objectives and the learner's experiences. It presents a triad of elements comprising leaner's objectives, experiences and evaluation. The model generates three main questions: (1) What are the main aims and objectives of the curriculum? (2) What experiences meet these aims? (3) How can the attainment of these objectives be evaluated? The key characteristics of Tyler's curriculum development model are presented in Figure 1.

This model has served as a basis for organising the curriculum for over 50 years in many developing countries, including Zimbabwe, and has resulted in the formulation of such models as Baker and Popham (1973), which have been criticised for their over emphasis on learning objectives and were viewed as employing very technical, means-to-end reasoning (O'Neil & Murphy, 2010).

It must be admitted here that the Tylerist curriculum development model avoids general statements of intent. It provides clearly defined aims and objectives that are achievable. It allows for precise assessment and helps the teachers to clearly identify skills and competencies that need to be mastered. On the other hand, it is pertinent to argue that such objectives-based models

minimise the significance of other contributory milestones in the development of a curriculum, such as the requisite inputs and processes which impact on the successful development of a curriculum. The model has also been criticised for trivialising and splitting issues, particularly at lower educational levels. The objectives themselves are sometimes difficult to develop and, in some instances, they discourage creativity as the learner is forced to narrowly focus on the stated objectives. Furthermore, this model advocates and enshrines the behaviourist psychology and philosophy to the exclusion of other progressive philosophies (Neary, 2002). Thus, the Tyler model and its subsequent branches perceive the curriculum from a positivist, deductive perspective and work from a basis of scientific management with a preference for education administrators developing the curriculum and having the teachers implement it. Thus, while useful in developing a positivist, deductive curriculum, a Tylerist deductive curriculum model fails to accommodate the perception of learning experiences as a social construct reflecting power and value conflicts that are a result of negotiations and persuasion. Despite its shortfalls as a development model, the objectives aspect of the Tylerist model will be accommodated in constructing the indigenous knowledge–science (IK-SCIE) curriculum model. These objectives will be used for providing guidelines for selecting learning activities and, subsequently, as the criteria for evaluation.

Figure 1. Characteristics of Tyler's curriculum model

1. The curriculum focuses on objectives, experiences and evaluation.
2. The language used is consistent with the model's behavioural philosophy.
3. The product outcomes have to be observable and measurable.
4. Learning is perceived as a change of behaviour.
5. The curriculum is deductive, starting from a conceived generalisation and progressing to specifics.
6. The curriculum is product-oriented and teacher-developed.

Hilda Taba's curriculum model

Another curriculum development model that is commonly applied in the development of most curricula is Hilda Taba's (1962) inductive curriculum development model that is typical of a process model. Neary (2002:39) described the process model as one which emphasises 'activities and effects'. Hilda Taba's model is inductive in nature, proceeding from specifics towards the general, unlike deductive models that start with the general and proceed to the specific. Knight (2001) observed that the inductive process models such as Hilda Taba's make logical sense in that what matters in learning and teaching is not so much the product on its own but the processes, messages and conditions. If these are in place, good outcomes will follow. On the same note, Hussey and Smith (2008) and Maher (2004) have extolled the advantages of such models. For example, Hussey and Smith (2008:367) maintain that:

> accepting that learner motivation is an essential element in learning, we propose that those who teach should begin to reclaim learning outcomes and begin to frame them more broadly and flexibly, to allow for demonstrations and expressions of appreciation, enjoyment and even pleasure, in the full knowledge that such outcomes pose problems for assessment.

Hilda Taba's model is linear and hierarchical, starting with the diagnosis of the learner's needs and the expectations of society. While the linearity aspect of the model would not be consistent with a negotiated IK–SCIE curriculum, it should be acknowledged that the aspect of addressing the needs of the learners and the society in which they operate will be acceptable to both a science-based curriculum and an IK-based curriculum. In essence, this translates into the involvement of the community and acceptance of community knowledge, its culture, values and beliefs. In the case of learners studying agriculture, for instance, it is imperative that their needs are addressed. Taba's model uses these identified needs to determine the objectives of the curriculum. The rest of the model focuses on the development process. The key steps in Hilda Taba's curriculum model are illustrated in Figure 2.

Figure 2. Stages in Taba's curriculum model
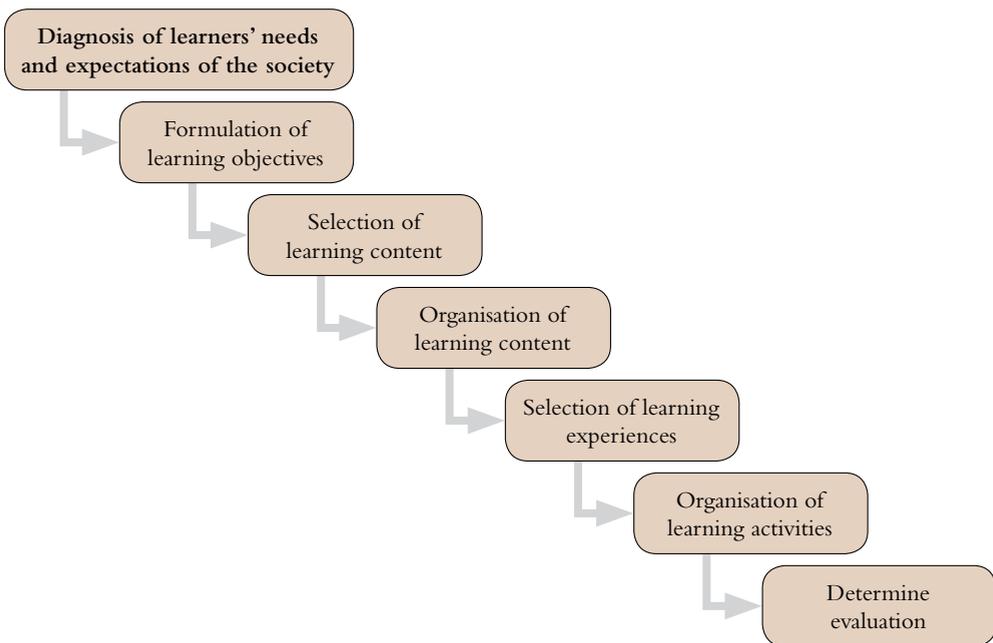
Hilda Taba's model tends to emphasise the learners' activities and emphasises the role of the teacher's knowledge, which is often Eurocentric to the exclusion of the community-constructed knowledge of the learners. After all, most agriculture teachers, particularly in Zimbabwe, are products of the science-based curriculum that is deeply rooted in western behaviourist philosophy. While it is logical to involve the teachers in curriculum development, Taba's model over utilises and emphasises the teacher, whose understanding of divergent IK in some instances may be limited. This is pertinent in Zimbabwe's case, where teachers are products of a miscellany of cultures and backgrounds. In this study, teachers' knowledge would be utilised in the development of the curriculum that is at par with that of the indigenous communities' cultural practices.

While this study perceives Taba's model as reflecting learner's needs and teacher's knowledge as reflected mainly in the western science-based curriculum, it appreciates the centralisation of the learner, albeit with supportive scaffolding from the community. The argument here is that learners on entry into colleges do have their own community-based knowledge which can be incorporated into the curriculum, as reflected in the constructivist school of thought. Thus, the learner's background knowledge will be integrated into the proposed curriculum framework. Another, key feature of the Hilda Taba curriculum that will be incorporated will be its inductive nature. As observed, deductive approaches tend to be rigid and give no room for a negotiated curriculum. The objectives, aims and knowledge values are pre-set and predetermined. In this study, the proposed curriculum framework allows for flexibility and negotiation as consistent with IK epistemology. Thus, from this model, the eclectic curriculum framework used will entail the determination of learner and societal needs. It will also be informed by Taba's process model, which identifies the learners' needs, selects the learning activities and reorganises the activities into usable integrated structures.

It should be noted that the stages subsequent to the interest of the learners include selection and organisation of content and learning experiences. These will be negotiated and confirmed by the community elders who, in most cases, are repositories of traditional knowledge. In the proposed curriculum framework, the approach will not necessarily be linear but may adopt a more reiterative approach.

IK is by its nature grounded in the epistemological perspective of knowledge as a social construct, and therefore a curriculum that aspires to infuse and integrate IK would not readily lend itself solely to a model that is grounded in the absolutist perspective such as the Tyler and Taba models of the curriculum development. Concurring with this view, Walker (1971:51) states that these 'classical models despite their success seem not to effectively represent the characteristics of traditional educational practice'. It is for this reason that this study would not solely adopt the otherwise classical curriculum models as presented by Ralph Tyler and Hilda Taba. This is consistent with Emeagwali's (2003:1) view that at the core of the mainstream of the western curriculum 'is a desire to negotiate nature through sequential processes such as hypothesis formulation, experiment and prediction'. An IK-SCIE curriculum will not readily fall into this presupposed 'neat linear' model of curriculum development.

Lawton's selection from culture curriculum model

Lawton (1973) developed his selection from culture curriculum in an effort to underplay the behaviourist-based objectives curriculum models as developed by Tyler (1949). In his model, the curriculum is perceived as a whole way of life of a society whose educational purpose is to select and transmit aspects of culture that are considered as most worthwhile and deserving of being passed on to the next generation (Emeagwali & Dei, 2014). Lawton's selection from culture assumes that the teacher knows the worthwhile cultural aspects that need to be transmitted to the next generation. The assumption is that the teacher uses the knowledge of philosophy, psychology and sociology in making the selection of culture. In support of this approach, Stenhouse (1975) states that this selection from culture should result in worthwhile knowledge that should lead to societal betterment. Lawton's curriculum subdivides the culture into nine components (see Figure 3).

Figure 3. Lawton's cultural analysis model
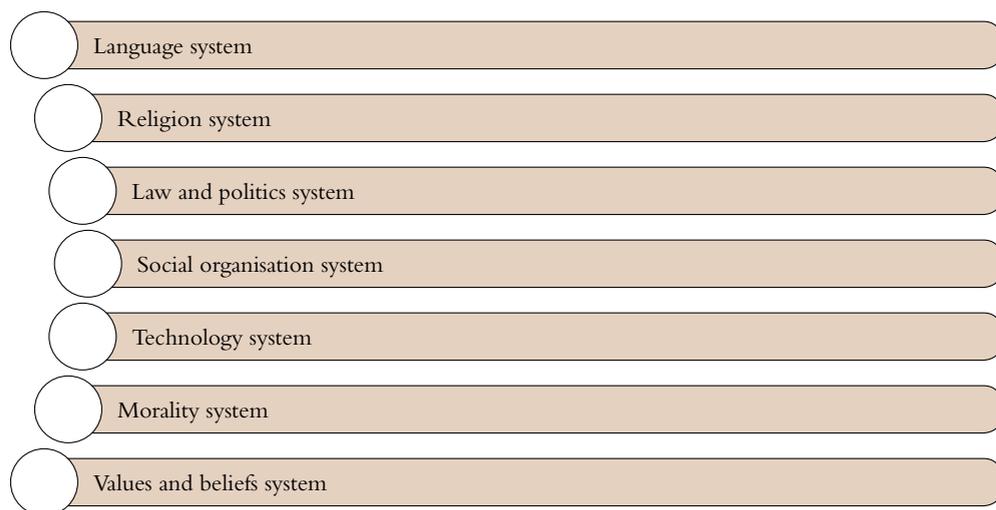
Lawton attempts to develop a curriculum that addresses all the key cultural dimensions that are global in nature. Lawton's nine systems help to ensure that as many cultural dimensions are taken aboard. Thus, the model will be used to ensure that all aspects of the cultural systems are included in the developed curriculum. Thus, in developing a negotiated curriculum taking aboard IK, it is important that the negotiation lens be broadened to include methodological and knowledge pluralism.

Developing the curriculum using Stufflebeam's CIPP model

Curriculum evaluation models are meant to explain the process of evaluating already existing programs. Stufflebeam's context, input, process and product evaluation (CIPP) model is 'a comprehensive framework for conducting formative and summative evaluations of project, personnel, products, organisations, and evaluation systems' (Stufflebeam & Shinkfield, 2007:34). It originated in the late 1960s to provide greater accountability for the inner-city school district reform project in the United States. It was to address the limitations of traditional evaluation approaches (Stufflebeam, 1971). The CIPP evaluation model 'is configured especially to enable and guide comprehensive, systematic examination of socially and educational projects that occur in the dynamic, septic conditions of the real world' (Stufflebeam & Shinkfield 2007:35).

The Stufflebeam's CIPP model is made up of four components which are very significant in the curriculum development processes: context evaluation, input evaluation, process evaluation and product evaluation. According to Stufflebeam (2003), the objective of context evaluation is to assess the overall environmental readiness of the curriculum, examine whether existing goals and priorities are attuned to the needs of the community and learners, and assess whether proposed objectives are sufficiently responsive to assessed needs. The purpose of an input evaluation is to help prescribe a programme by which to make needed changes. During input evaluation, experts, evaluators and stakeholders identify or create potentially

relevant approaches. Then, they assess the potential approaches and help formulate a responsive plan. Process evaluation affords opportunities to assess periodically the extent to which the curriculum is being carried out appropriately and effectively. Product evaluation identifies and assesses curriculum outcomes, both intended and unintended.

Stufflebeam and Shinkfield (2007) suggest that a combination of techniques should be used to assess a comprehensive set of outcomes. Doing so helps to cross-check the various findings. However, the product evaluation is a key feature of all technocist curriculum models and since the intended curriculum is an IK curriculum, its focus must necessarily be on community consensus and validation more than on assessing the attainment of predetermined objectives. In fact, it is argued here that the key determinant of the curriculum development model to be used in this study is the nature of IK. IK forms an indivisible, integral part of a society's culture, values, norms, beliefs and rules.

In this study, unlike in the other instances where the Stufflebeam's model has been used for evaluation purposes, some aspects of the model will be used to ensure a sequential development of the curriculum. It is the view in this study, that if a model can logically and sequentially evaluate a programme, it is only proper to assume that the same model can be used to develop a new curriculum or modify an existing one. This study believes that certain benefits are realised from using the same model for curriculum development and evaluation, especially when the framework from the curriculum evaluation is grounded in the curriculum for development. The CIPP model is uniquely ideal for development of an IK-SCIE curriculum by evaluating the current agricultural curriculum, as its most fundamental tenet is 'not to prove but improve existing programmes' (Stufflebeam & Shinkfield, 2007:329). Table 1 shows how the study intends using some aspects of the model for curriculum development instead of curriculum evaluation.

The CIPP model, while providing a logical sequential curriculum development model, tends to be too positivist and technocist, and is likely to produce a curriculum that is absolutist, linear and traditional in orientation. The resultant curriculum is likely to 'be informed by the theory of linear articulation' (Mthunzi, 2001:292), which assumes a linear curriculum development process. In this light, it will be inconsistent with IK epistemology to solely rely on and utilise the CIPP model in the development of the IK-SCIE-based curriculum. As Urevbu (1985:15) aptly observed, 'Most central questions of curriculum are normative in the sense that they involve choices among many competing values.' Thus, the CIPP model will be used conjointly with other models discussed. In essence, therefore, the intended IK-SCIE curriculum will be developed following the stages as presented by Stufflebeam, but also incorporating models already discussed above. Thus, the curriculum model to be used will be eclectic in nature and not based on one model.

Table 1. The Stufflebeam components to be used in curriculum development

CIPP model component	Use for curriculum development	Use for curriculum evaluation
Context	To define the operating context within which the curriculum will be delivered. Determine the specific characteristics of the learners. To establish a rationale for the determination of the curriculum objectives.	To define the environment relevant to the curriculum, describing the actual and intended conditions of the programme, identifying unmet needs, and diagnosing barriers that prevent needs from being met.
Input	To identify and assess the capabilities, strategies, and designs available for implementing the curriculum as related to the to the curriculum's objectives. Determine what internal resources are needed to enable achievement of the objectives and to search for external resources when required. Also, the input phase considers the cost to implement the curriculum.	To determine the extent that available resources were used to achieve the curriculum objectives.
Process	To identify the procedural design that will be used to implement the curriculum. The curriculum objectives are translated into specific activities that constitute the instructional design.	To identify deficiencies in the procedural design or in the implementation of the curriculum, i.e. what actually took place during instruction? To provide information necessary to make modifications to the implementation strategies used during instruction. To maintain procedural documentation.

Source: Stufflbeam and Shinkfield (2007)

Mthunzi's entrepreneurial curriculum model

Mthunzi (2001) argues that the current curriculum projects 'the acquisition of traditional academic conformist attributes and skills'. According to him, the traditional curriculum is based on the assumption of an educated individual as one having a mastery of information, facts and knowledge, able to critique and analyse and reproduce what has been learnt. The teaching and learning strategies are those that centralise the enhanced teacher authority and monologise the process of learning. As a challenge to the traditional curriculum, he proposes a theoretical curriculum framework that embodies a triad equi-projection of entrepreneurial attributes and skills, academic knowledge and self-management skills. Mthunzi (2001) presents a comparative theoretical paradigm that reflects the key characteristics of his intended curriculum (see Table 2).

However, an omission in the model is the absence of IK and its lack of clear developmental stages. In the place of IK, the model emphasises entrepreneurial skills. It is for this reason that the model on its own remains inadequate and it is in this light that the research proposes an

eclectic model that takes cognisance of values as expressed by the interpretivists and absolutists. The proposed eclectic curriculum model allows for a negotiated IK-SCIE curriculum that is informed by both the western scientific approach and the indigenous knowledge systems (IKS), capable of demonstrating 'autopoiesis' (Govender, 2012:113). It is in this vein that this study proposes the use of an eclectic curriculum framework to develop the IK-SCIE curriculum for the agricultural college.

Table 2. A comparative analysis of Mthunzi's model and the traditional objectives-based model

Curricular characteristics	Traditional paradigm	Proposed paradigm
Epistemology	Reductionist	Constructivist
Knowledge	Transferred in its totality from teacher to student and sustained through memorisation, regurgitation and fear of failure	Negotiated and reconstructed through students and teacher experiences. Knowledge in constant flux
Knowledge utility	Reproduced undigested and non-utilitarian	Recreated and sourced for a specific utilitarian purpose
Key attributes	Critiquing, analysis and conformity	Confidence, creativity, innovativeness and self-autonomy
Pedagogical focus	Examination-oriented	Non-examinable, self-management
Teaching approaches	Teacher-centred; teacher as subject expert, passive participation by students	Teacher as part of networking, teamwork, investigative, experiential and active participation by students
Classroom dynamism	Rigidity in learning environment, schedules, timetabling, rooms, teachers and student positions	Flexibility in learning environment, schedules, timetables, modules
Articulation	Disjunction between school and community	Consonance between school and community
Devolution of power	Teacher has power, exercises authority and control	Individual learner is empowered to learn, community contributes

Source: Mthunzi (2001)

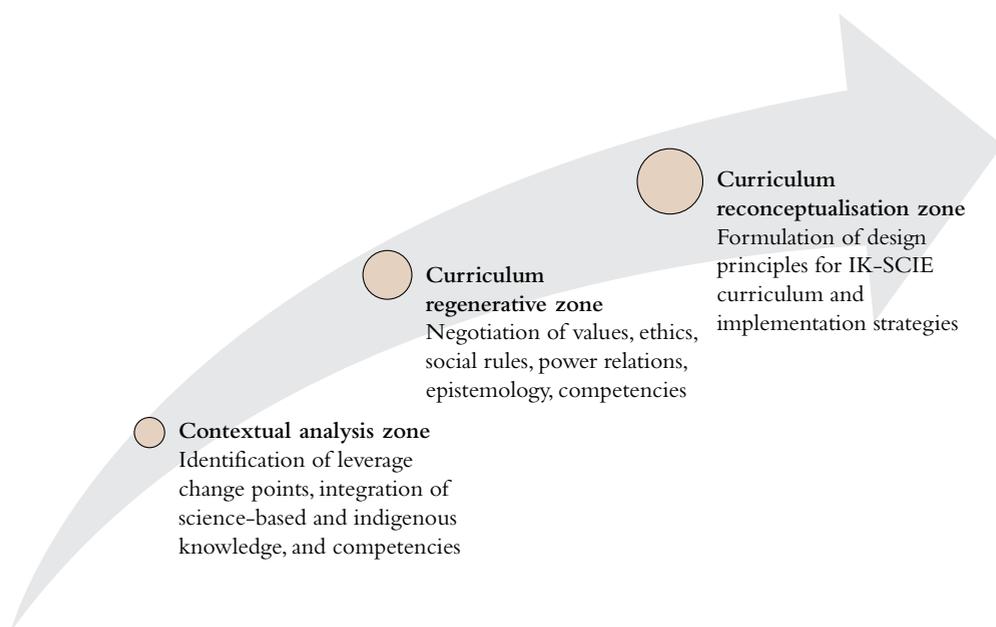## IK-SCIE curriculum: A proposed eclectic framework

IK forms an indivisible, integral part of a society's culture, values, norms, beliefs and rules. Consistent with the nature of culture, it is 'a complex, nonlinear, dynamic with multiple feedback loops' (Govender, 2012:125). Lawton (1986) also posits that a curriculum is a selection from culture and is therefore deeply rooted in culture. Thus, a study of the curriculum should necessarily involve an analysis of the power conflicts, values and contentions within the competing cultures. If the current Eurocentric science-based curriculum is to be meaningfully analysed with the intention of developing a negotiated IK-SCIE curriculum that is informed

by both the western scientific approach and the IKS capable of demonstrating autopoiesis (self–generation), it is imperative that it be analysed, interpreted and formulated within the complexity curriculum framework as presented in Figure 4 below.

The proposed study framework is eclectic in that it acknowledges that existing individual curriculum models that are Eurocentric and technocist cannot on their own provide an adequate framework for developing an IK-SCIE curriculum. It therefore incorporates various aspects from different models (see Figure 4).

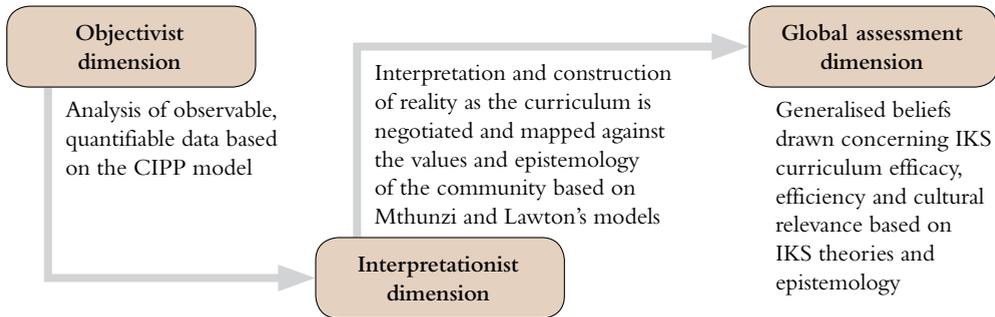**Figure 4.** A proposed eclectic curriculum development framework

The proposed eclectic framework assumes a triad of research events: the contextual analysis zone of the reductionist science-based curriculum, the curriculum regenerative zone and the curriculum reconceptualisation zone.

The contextual analysis zone
At the contextual analysis zone, micro curriculum analysis is carried out to identify key leverage points of change and transformation. This zone determines the areas of weaknesses, tension and points of exclusion within the existing science-based curriculum. In this zone, Stufflebeam's CIPP stages will be used to ensure that all the curriculum development aspects have been examined and the weaknesses and strengths identified. The justification for the use of the CIPP model in this zone is that it covers all the curriculum development stages. It thus allows for areas of strength and weakness to be exposed in the whole process – unlike the Tylerist model, which would focus on the product to the exclusion of the process. However, the model, being positivist, may not be able to reflect underlying conflicts of control and power struggles within

the curriculum. Sources of power struggle, tension and points of change will be identified through intepretivist approaches which will allow for the quantifiable data to be analysed further using the intepretivist approach (see Figure 5).

Figure 5. The interpretivist approach

Objectivist dimension

Analysis of observable, quantifiable data based on the CIPP model

Interpretation and construction of reality as the curriculum is negotiated and mapped against the values and epistemology of the community based on Mthunzi and Lawton's models

Global assessment dimension

Generalised beliefs drawn concerning IKS curriculum efficacy, efficiency and cultural relevance based on IKS theories and epistemology

Interpretationist dimension

The interpretationist dimension provides an analysis arena where the data generated regarding the existing curriculum will be further interrogated, interpreted and constructions of reality made rather than making simple recordings of objective and observable quantifications of data which would have been done at the objectivist tier. At this level, the values, attitudes and perceptions of the key players in the curriculum are analysed.

The global dimension assessment, the third dimension, includes implementers' and learners' judgements, behaviour and attitudes towards the curriculum. At this dimension, analysis is made of the individual's generalised beliefs and opinions about the efficiency, efficacy and cultural relevance, utility and impact of the existing curriculum. Despite the fact that the conceptual representation tends to be linear, the actual analysis may be reiterative and thus necessarily untidy and not linear.

The curriculum regenerative zone
The curriculum regenerative zone will be used as the zone of negotiating the infusion and integration of IK attributes, including the overarching values, ethics, social rules and power relations and the dominant features such as bodies of knowledge, attitudes, skills and competencies. At this stage, the representatives of the community present their perceptions of what should comprise a curriculum for agriculture. In this case, they determine the content, the activities and experiences they consider relevant to their communities. In essence, they provide their own perception of what they consider worthwhile in agriculture. They define the community knowledge and skills as they perceive them. At this stage, the curriculum model used will be Mthunzi's (2001) model that perceives knowledge as a social construct. This is consistent with the worldview theory that recognises that learners construct knowledge from their own social cultural experiences. Ogunniyi (2003) and Jegede (1996) have argued that learners' understanding of any new meaning is strongly influenced and determined by prior knowledge that in turn is determined by cultural beliefs, traditions and customs governed by a worldview. Knowledge according to this model is negotiated and reconstructed through

community experiences. Knowledge is in a state of flux and is not permanent and as such can be sourced for use and application. Semali and Kincheloe (1999) also argue that understanding knowledge as changing and evolving is of particular interest in research involving IK, which is sometimes thought to be lacking in dynamism. This increases articulation between the school and the community and the ease of transfer of knowledge between them. In this model, it is the community that has the ownership of knowledge, unlike in the Hilda Taba models where the teacher is the kingpin in the determination of what is worthwhile knowledge. Elements of Lawton's model of selection of curriculum content from a culture will be used to ensure that the curriculum is not narrowed down.

The reconceptualisation zone
The third envisaged stage is the curriculum reconceptualisation zone. At this stage, infusion and integration will be carried out. This stage is consistent with the worldview epistemological perception, whose fundamental epistemological posit is that people understand and interpret what they perceive to be reality from different perspectives based on their values, norms, ethics and beliefs. People from different geographical locations and cultures tend to differ in their perceptions of the world and its processes. Kawagley (1995) states that the concept of the worldview is very closely related to the definitions of the culture and cognitive maps that different people possess. Kawagley (1995:8–9) further states that

> among the indigenous cultures the worldviews include values, traditions, customs, myths, legends, stories, family, community and examples set by community leaders, a summation of coping devises that have worked in the past and may or may not be as effective in the present.

Consistent with this theory, this study acknowledges that different communities among indigenous cultures tend to have their own worldviews, unlike the conventional scientific worldview which tries to unify all world views.

These fundamental beliefs about the world then exert a powerful influence on how sense is made of world events. Thus, if an indigenous learner is to benefit from the curriculum, it must necessarily reflect his/her indigenous context. Since individuals have many ways of perceiving nature, science, the surrounding world and their place in it, understanding science concepts depends on their worldview (Odegaard, 1999). In such a scenario, three pertinent issues arise, namely, whether the curriculum accommodates differences in the worldviews, accepts negotiated responses, and how the curriculum accommodates different ideas and beliefs such as IK.

It is at this reconceptualisation zone that the two bodies of knowledge – western science and IKS are integrated to form a single holistic body of content. This is the stage where mitigating strategies for implementation will be developed. At this stage, community and college experts may validate the soundness and efficacy of the newly developed IKS programme. This study calls for a theoretical framework that views IKS and western science not as two diametrically opposed poles but rather as equal and complementary cosmologies. These, 'when carefully analysed, can be harmonized, infused and integrated into an IK–SCIE curriculum that embraces the tenets and synergies from both worlds', as proposed by Ogunniyi (2003:12) in his argumentation theory.

IK–SCIE education is based on theories of learning developed from the cross-cultural perspective. According to this view, for most students the transition from their life-world into the science classroom is a cross-cultural experience (Aikenhead & Jegede, 1999). With this thought, this study would make use of some learning theories informed by, among others, post-colonial theory (Carter, 2006), worldview theory (Kawagley, 1995) and social cultural theory (Bandura, 1977). These theories would be relevant in studying how IK is experienced and learnt in the field. The common thread that runs across these theories is that they acknowledge there are multiple ways of knowing and all should be given time and space in our educational curricula/institutions.

At the reconceptualisation stage, the western science content of the curriculum will be re-assessed to identify and weed out those bodies of knowledge, skills, attitude and competencies that, in line with post-colonial theory, are not consistent with the values of the society. According to Carter (2006), post-colonial theory is a theoretical tool that opens channels for revising philosophical frameworks that no longer work well in a post-colonial environment. Odora-Hoopers (2002) posits that the post-colonial theory is an examination of the impact and continuing legacy of the western conquest, colonisation and domination of non-western lands, students and cultures. On the other hand, Mansour (2008) argues that post-colonial theory is an engagement framework on issues like power structures and social hierarchies, with an emphasis on the inclusion of other forms of knowledge such as IK. Supporting the use of this theory in the study of IK, Dei (2000) states that there should be a hybridisation of knowledge bases in the educational curricula. Furthermore, Martin (2007:42) contends that

> post-colonial theory has the potential of ushering in new models of education that embrace multiculturalism, engage diverse ways of knowing and ensure that the curricula are relevant and sustainable to a specific cultural and community setting.

An IK curriculum should of necessity be embedded in socio-cultural theories. At the reconceptualisation stage, the socio-cultural aspects will be sourced from the local society and its culture consistent with Vygotsky's socio-cultural theory, which states that 'the mechanism of individual development change is rooted in society and culture' (Vygotsky, 1978:7). This implies that thought and knowledge are not free from social and cultural influences. The socio-cultural theory is widely applicable across disciplines and can be useful in the study of IK and science education. Lemke (2001) stresses that the use of socio-cultural theory enables us to view dynamic processes, such as human social activities, occurring within agricultural institutions. The theory is also of particular importance in social research as it acknowledges change and the evolution of knowledge in time and space. This study makes use of the social cultural theory to enable the researcher to appreciate the nature of IK and its attachment to the dynamic social and cultural processes of indigenous people.

Conclusion

The IK-SCIE integrative agricultural college curriculum model outlined in Figure 3 is embedded in the complexity theory. As Davis, Phelps and Wells (2004) assert, complexity is concerned with

non-linear dynamics, emergence and self-organisation. It is a formal attempt to explore how simple, sometimes non-purposive, components in a system can self-organise, emerge or evolve into a coherent purposive and complex whole. Similarly, the IK-SCIE integrated agricultural college curriculum model proposed in this study is not linear and neither is it arboreal. It observes a major tenet of the complexity theory – as propounded by Govender (2012), Johnson and Christenson (2001), Sanford and Hopper (2009), Salen (2008) and Salen, Tekinbas and Zimmerman (2004) – that a curriculum that is rooted in the complexity theory must of necessity immerse itself in the communities in which it is expected to operate. The proposed curriculum model looks up to the community elders, the college learners, college lecturers and Agritex Officers[1] for its creation. It thus becomes a product of interaction, persuasion and negotiation.

Endnote

1. Agricultural Technical and Extension Services Officers are trained in agricultural colleges to assist communal farmers with following scientific farming methods.

Notes on the contributors and their contributions

Lead author
Ndlovu, Christopher | University of KwaZulu-Natal, South Africa
ORCID 0000-0003-1758-6055 | chrisndlovu47@gmail.com
Christopher Ndlovu, a National Institute of Humanities and Social Sciences (NIHSS)-funded scholar, is currently a senior lecturer in the Department of Educational Foundations at Lupane State University, Zimbabwe. His key research areas include indigenous knowledge systems, curriculum innovations and contextualisation, environmental management and rural learning ecologies. He wrote this paper while affiliated with the University of KwaZulu-Natal, South Africa.

Co-author
James, Angela | University of KwaZulu-Natal, South Africa
ORCID 0000-0003-4644-1373 | Jamesa1@ukzn.ac.za
Angela James is a senior lecturer in Science Education in the School of Education at the University of KwaZulu-Natal. Her pedagogy is informed by phronesis, that is, problem-solving in authentic contexts where meaning is created and competence developed. Her research interests include research and service-learning, professional development of student teachers, and science and culture.

Co-author
Govender, Nadaraj | University of KwaZulu- Natal, South Africa
ORCID 0000-0002-3406-0605 | Govendern37@ukzn.ac.za
Nadaraj Govender is Associate Professor in Science Education at the School of Education, University of KwaZulu-Natal. His published research has covered indigenous knowledge

systems (IKS) and the integration of IKS with science education, amongst other topics. He currently holds an NRF C2 rating. His research interests include physics/science education and IKS.

Areas of contribution	Authors	Percentage contribution
Conception or design of the paper, theory or key argument	C. Ndlovu	50%
	A. James	25%
	N. Govender	25%
Drafting the paper	C. Ndlovu	60%
	A. James	20%
	N. Govender	20%
Critical review of paper	C. Ndlovu	30%
	A. James	40%
	N. Govender	30%

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Viewpoint: Indigenous knowledge systems and environmental social work education: Towards environmental sustainability

Mogomme Alpheus Masoga, University of Zululand,
and Allucia Lulu Shokane, University of Venda, South Africa

Abstract

Prior to colonisation, most indigenous communities were using indigenous knowledge systems (IKS) as part of their livelihood. The livelihoods of rural and indigenous peoples and those living in poverty are often closely tied to the use of biodiversity. Positive action, if taken in these communities, could decrease pressure from climate change impacts. Indigenous knowledge can be a sustainable development and livelihood tool that can be used throughout the Global South. The key research question explored in this paper is: Which IKS applied by marginalised communities can be used by environmental education and social workers to advance environmental sustainability? Afro-sensed and sustainable livelihood approaches have been adopted to guide the theoretical framework. The qualitative research methodology followed a descriptive and explorative design. The research findings concluded that the integration of IKS in social work and environmental education can contribute to environmental sustainability efforts. Finally, a recommendation is made on how social sciences and educational practitioners can work with marginalised communities to adapt IKS.

Key words: indigenous knowledge systems, social work, environmental sustainability, livelihoods.

Introduction

Indigenous knowledge systems (IKS) are observed as interrelated to the continued existence of communities in general or specific fields, such as in the protection and use of the local environment and enhancing food security (Masoga, 2017). The importance of mainstreaming IKS for the realisation of human rights, sustainable development, poverty eradication and disaster reduction has been recognised in a series of international instruments such as the United Nations (UN) Declaration on the Rights of Indigenous Peoples, the Ahmadabad Framework on Environmental Education, the UN Declaration on Human Rights, the UN Covenant on Civil and Political Human Rights, and the UN Covenant on Economic, Social and Cultural Rights. The UN Declaration on the Rights of Indigenous Peoples (2007) acknowledges the importance of indigenous knowledge, cultures and traditional practices for sustainable and equitable development and proper management of the environment. In this context, our understanding of the environment is based on the work of Mokuku and Janse van Rensburg, which summarises the environment as 'a dynamic web of interconnected biophysical, economic, political and socio–cultural contexts in which people are involved' (1997:32). Consequently, we argue that indigenous knowledge is not widely accepted as a significant factor in the development of marginalised communities.

Mokuku and Janse van Rensburg (1997:31) maintain that 'the political dimension of the environment web requires that some environmental problems be traced to the colonial rule' and criticise the dominant imported knowledge systems for their silence in defending the exploitation of local communities and the whole of the environment. Prior to colonisation, communities throughout the Global South had been using IKS as part of their livelihood (Masoga & Shokane, 2018). The legacy of apartheid failed to acknowledge people's IKS and the environment (Mokuku & Janse van Rensburg, 1997; Mwansa, 2011, 2015; Prah, 2016). Magoro and Masoga (2005) attest that the system of apartheid in South Africa left many people poor, desolate, jobless and without proper education. Though not all aspects of western knowledge systems have been devastating, their dominance over African IKS has had disturbing effects on the current education system in Africa, including in South Africa. As a consequence, Prah (2016) notes that the colonial and apartheid educational systems created not only a sense of disaffection with, or a desire to dissociate from, the native heritage, but also affected the individual's sense of self-confidence. Mwansa (2011) further affirms that the effects of colonialism and apartheid are still visible in South Africa and are manifested in various social issues such as poverty, disease and hopelessness. This is pertinent to the practice of social work, which holds out a promise to restore the dignity of millions of South African people, which has been lost because of colonial and apartheid history (Mwansa, 2011).

The United Nations Development Programme (UNDP, 2007) declared that the historic marginalised and colonised countries – with limited access to resources, restricted rights and no voice in decision-making – are extremely vulnerable to environmental impacts. Kalu (2008) contends that scholarly research and discussion around the colonial and postcolonial situations have often ignored the dynamic process of African peoples' estrangement from their heritage. Mokuku and Janse van Rensburg have noted (1997:34) that local knowledge and heritage were also often ignored by indigenous peoples themselves, as well as curriculum developers 'in a predominant reliance on imported knowledge systems from external "experts" for development'. It is against this backdrop that the research objective was formulated to explore how marginalised communities apply IKS towards maintaining their livelihoods, and whether this can be used for sustainability efforts in the context of what we would call environmental social work.

In recent years, decision-makers in programmes and policy development addressing environmental challenges such as climate change have acknowledged that they lack knowledge about the links between social work and indigenous knowledge. It is essential to comprehend the connotations of both concepts. Social work can be understood as 'a practice-based profession […] underpinned by theories of social work, social sciences, humanities and indigenous knowledge, [which] engages people and structures to address life challenges and enhance wellbeing' (IFSW, IASSW & ICSW, 2012:1). Indigenous knowledge is known to be local and generated within communities (Masoga, 2017). Shava and Manyike (2018:36) further differentiate indigenous knowledge as 'transgenerational, transmitted from generation to generation orally (through narratives, stories/folklore, songs and poetry), visually (through arts, such as "bushmen" paintings, writings, craft, cultural rituals and dance), practically (through doing and the artefacts associated with practice) and spiritually (through dreams and visions

from the ancestors)'. In addition, Masoga (2017) emphasises that IKS emanate from the human spirit and life experiences organised and ordered into accumulated knowledge with the objective of utilising it for quality of life and to create a liveable environment for both human and other forms of life. Shava and Manyike (2018), as well as Masoga (2017) and Shava (2013), consider the main features of indigenous knowledge to include people, space and context, culture, language, knowledge and practices that are dynamic. Furthermore, the aforesaid authors cogitate that IKS should be based on innovation, adaptation and experimentation. Subsequently, Shava, Zazu, Tidball and O'Donoghue, (2009:218) affirm that indigenous knowledge can be utilised as 'a resource for community sustenance in contexts of environmental risk, vulnerability and uncertainty through education processes within local contexts'. Against this backdrop, it is contended that working with IKS and environmental social work education will determine the form and content of the African development strategy: to ensure that developmental change on the continent should accommodate itself to the values, interests, aspirations and/or institutions that are important to African people's lives. In principle, 'environmental education should encompass the development of environmental awareness, knowledge, values, responsibility and action' (Reddy, 2017).

Environmental social work education and IKS

The expiration of the Millennium Development Goals (MDGs) in 2015 opened the opportunity for new global road maps for pursuing development priorities. This was evident in the UN and its member countries agreeing to address environmental sustainability and related global inequities through the signing of the Sustainable Development Goals (SDGs). Any country that is a member of the UN is also engaged by the UN Development Policy to raise views, share practical experiences and to make recommendations in respect of the SDGs.

This paper was also motivated by the Global Agenda for Social Work and Social Development's commitment to action toward environmental sustainability as one of the four pillars of Global Agenda (Jones & Truell, 2012; Rinkel & Powers, 2018). Recognising that past and present political, economic, cultural and social orders, shaped in specific contexts, have had unequal consequences for global, national and local communities and have negative impacts on marginalised people, the four pillars of the Global Agenda (Jones & Truell, 2012) were developed as follows:

- Promoting social and economic equalities;
- Promoting the dignity and worth of peoples;
- Working toward environmental sustainability; and
- Strengthening recognition of the importance of human relationships.

Noting that 'across the globe, evidence abounds that environment is in a crisis', Rinkel and Powers (2018:16) call on social and humanities professionals to focus their research energies on environmental sustainability as part of their contribution to the Global Agenda. We call on these professionals, including environmental education specialists and social workers, to value

traditional knowledge and innovations as part of their engagement with their communities. These could safeguard communities with respect to inclusion, sustainability and fulfilment (IFSW, IASSW & ICSW, 2012).

Shokane (2016:104) maintains that 'the effects of climate change affect everyone, but disproportionately the most vulnerable population which includes the young, the old, those with chronic illnesses, and the poor and people living with disabilities, which the social work profession mostly caters for'. Thus, environmental issues impact not only the socio-political, economic and physical environment in which social workers are engaged, but also the type of work social workers will be called upon to carry out (Dominelli, 2012; Gray, Coates & Hetherington, 2013).

Problem statement

Though there is emerging literature on environmental social work education (Dominelli, 2011, 2012; Gray, Coates & Hetherington, 2013; Lysack, 2008; Shokane & Nel, 2017), there has been little engagement with IKS and how marginalised communities can work towards environmental sustainability (Masoga & Shokane, 2018). Thus, the researchers were challenged to conduct research that combines the fields of environmental education, social work education as well as indigenous knowledge, and focuses on how they can be integrated to address the needs of communities and how to engage with them effectively in working towards sustainability. The main research question explored in this paper is: Which IKS applied by marginalised communities can be used by environmental education and social workers to advance environmental sustainability?

Theoretical lens

In implementing this research, an African philosophical lens was applied. Africa is encouraged to move away from models that rely only on western frameworks and philosophies and move towards Afrocentric models based on indigenous knowledge systems, community-based interventions and local values and practices (Mwansa, 2010). Asante (1998:2) considers African philosophy to 'place African ideas at the centre of any analysis that involves African culture and behaviour'. In the context of this paper, the Afro-sensed theory described by Masoga and Shokane (2018) has been championed for its focus on indigenous knowledges and cultural approaches used to discover unique indigenous ways of dealing with environmental issues. This theory was developed by Masoga (2017) with the intention of guiding practitioners to mitigate against climate change impacts utilising IKS in a local, culturally appropriate and sensitive manner.

In addition to the Afro-sensed theory, the sustainable livelihood perspective (Chambers & Conway, 1992) was integrated for its value in assisting indigenous communities to remain sustainable utilising their IKS. The sustainable livelihood perspective focuses on both the assets and strengths (which would include IKS) as well as the vulnerability of people in coping with hardship and maintaining the IKS they have preserved. The composite definition of a

sustainable rural livelihood is applied at the community level to comprise 'the capabilities, assets (stores, resources, claims and access) and activities required for a means of living and its ability to provide opportunities for the next generation' (Chambers & Conway, 1992:7–8). It is worth emphasising that IKS involve assets and capabilities that can be used to improve the livelihood of the people. Since indigenous communities will be (and are) affected by global issues like climate change, their needs and interests need to be reflected at the community, national and international level.

Methodology

A qualitative research methodology was used which followed a descriptive and explorative design (Babbie & Mouton, 2001) and focused on IKS generated and recognised in the community as relating to environmental sustainability. This paper draws from data collected between August and October 2017 in the Ga-Sekororo villages of the Maruleng sub-district in Mopani District, Limpopo Province, South Africa.

Twenty key persons in the community (elders, parents, local authority representatives and community professionals such as farmers and traditional healers) were purposely selected for their deep insight on the topic under review to participate in a focus group discussion. Ethical clearance to conduct this study was obtained from the University of Venda Research and Publications Committee. Informed, written consent was obtained in advance from all research participants.

Field notes and an audio-recorder were used to record the oral data, which was later transcribed from Sepedi into English. Attention was paid to narratives or stories since they provide a cultural lens. Qualitative content analysis was used as 'a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns' (Hsieh & Shannon, 2005:1277). The content analysis involved a description of the IKS as described by the custodians of the IKS themselves. Of importance was the custodians' understanding of the meaning of their knowledge. What then followed was the interpretation of the underlying context. Issues of rigour and trustworthiness in conducting IKS research were addressed to ascertain the 'authenticity' of the findings (Zuber-Skerrit & Fletcher, 2007:423), that is, that the research results are valid and reliable if they are recognisable and authentic to the people involved in the research, even if not necessarily to others.

Findings

The findings are based on the three themes that emerged during the analysis of the data produced during the focus group discussion with indigenous knowledge holders, namely:

1. The lack of recognition in environmental sustainability efforts of indigenous knowledge holders;
2. The use of natural resources through IKS; and
3. IKS and the knowledge of indigenous plants.

Theme 1: The lack of recognition in environmental sustainability efforts of indigenous knowledge holders

The community members participating in the focus group discussion expressed a concern about their lack of recognition in environmental sustainability efforts. They narrated how they felt undermined by the government as they are not involved in environmental sustainability efforts in their community. In agreement, the participants expressed the following view: '*Ga re akaretšwe go diphetho tše di dirwago mabapi le phetogo ya leratadima le tlhokomelo ya tikologo mo setšhabeng*' [They are excluded in the decision-making regarding climate change and environmental sustainability].

The participants went on to say: '*Tsebo ya sekgale goba segologolo ga e tšeelwe hlogong*' [Their traditional indigenous knowledge is undermined in their community]. The participants specifically emphasised that the government was responsible for not recognising their IKS: '*Mmušo ga o tšeele hlogong tsebo ya segologolo le šetšo ge ba tšea diphetho tša bona*' [The government does not recognise their traditions, knowledge and culture in their decision-making].

Theme 2: The use of natural resources through IKS

The findings indicate that most people in the indigenous community of Ga-Sekororo depend greatly on the diversity of natural resources. The theme of utilisation of natural resources through IKS emerged as three sub-themes, namely, the preservation of food, water and energy.

Preservation of food

The participants reflected that their livelihood in terms of their food needs depends on IKS as follows: '*Re bjala dibjalo tše di kgotlelelago mabaka a komelelo*' [They only plant crops that are tolerant to drought]. They indicated that they can produce a variety of plants and crops but had to focus on those tolerant of high temperatures. The community uses their knowledge of drought-resistant crops to adapt to environmental hazards which affect food security and water management in rural areas. By allowing them to adapt their farming practices to climatic conditions, indigenous knowledge provides social security and environmental sustainability.

Moreover, the participants noted that: '*Re buna dibjalwa tša go swana le merogo, dimake, ditloo, mapampune le mafela*' [They harvest crops and grow traditional vegetables (*morogo*), leafy vegetables, groundnuts, pumpkins and mealies]. In similar research, Shava (1999: 85) affirmed that indigenous food plants have in the past played an important role in the diet of African communities.

Additionally, the participants also supported their livelihoods with indigenous knowledge about food production: '*Re iphediša ka dimela goba dibjalwa*' – which suggests that they use the crops for household consumption and income generation. Muchenje and Goronga (2015) note that production techniques based on IKS tend to ensure food security at the household level.

Preservation of water

The focus group participants indicated that their main challenge was the lack of clean and running water. They explained that they drink from the river – '*Re nwa meetse a go tšwa dinokeng*' and: '*Re ikanntše meetse a pula e bile re a šomišetša go nošetša dibjalwa le ge e le gore matšatši a lehono*

pula ga e sana gabotse' – which implies that they depend on rain to water their crops, 'though it does not rain often'. Drought, desertification, and erratic rainfall are challenges that will worsen with climate change. In a similar study, O'Donoghue, Shava and Zazu (2014) identified innovative indigenous practices for water conservation reflecting indigenous peoples' capacity to manage their local environment and to adapt to its related climatic changes.

Preservation of energy

The participants indicated that they still largely have to secure energy for cooking and heating through indigenous ways: '*Re ithekgile go di dirišwa tša hlago bjalo ka dikgong re apea dijo le go difuthumatš maregeng'* [They depend on natural resources such as firewood to cook food, boil water and keep warm in winter]. Firewood is their main energy source, although the cutting of trees for firewood exposes them to possible prosecution, fines and imprisonment: '*Bahlokomedi ba hlago ba a re golega ge ba re hwetša re rema dihlare'* [The rangers arrest them when the find them cutting trees].

The findings reveal an indigenous community collecting natural resources for fuel to a point where it has to be controlled by law. Elsewhere in the Global South, communities also use natural resources as food, medicine or fodder for their animals. The loss of, or reduction in, these resources will negatively impact their livelihoods. Without secure access to, and control over, natural resources (land, water, livestock, trees), the participants felt vulnerable, and linked these feelings to access to, or ownership of, farmland, as follows: '*Ga re kgone go hwetša lefase'*. In this context, 'vulnerability can be regarded as the degree to which a system is susceptible to and unable to cope with adverse effects of climate change including climate variability and extremes' (IPCC, 2007:16). According to O'Donoghue, Shava and Zazu (2014:36), indigenous knowledge serves as 'a source of local community resilience that provides an enabling capacity for people to sustain their livelihoods and adapt to environmental changes or new environments'. The most important measures for implementing IKS will be to increase the use of renewable energy, and to encourage reforestation while halting the rate of deforestation.

Theme 3: IKS and the knowledge of indigenous plants

The participants related that they possess knowledge of the diversity of plants and animals for medicinal purposes: '*Re le dingaka tša setšo rena le tsebo ya go fapana ka dihlare le diphoofolo tša naga tšeo ka moka re di šomišago go alafa balwetsi';* and that, 'due to our role as traditional healers and indigenous knowledge holders', they are able to treat their fellow community members*: 'Re šomiša dihlare tša hlago go alafa malwetši ao a sa tlwaelegago'* [They use herbs to treat common ailments].

Inspite of the fact that these local indigenous communities depend on these plants, they are often excluded from the management of these resources.

Discussion and recommendations

The findings suggest that indigenous knowledge holders are already using their knowledge for their livelihoods under difficult circumstances (little rain, high temperatures, no electricity or

running water, and dwindling resources such as trees). Some community members even have the knowledge to use plants for healing. Such holders of specialised knowledge can be powerful agents of change in efforts aimed at environmental sustainability. Holders of special indigenous knowledge often play a leading role in the community, and, by sharing their intellectual and social capital, could assist in the protection and management of natural resources.

Currently, communities feel vulnerable to prosecution for over-harvesting trees for fuel. However, IKS could be a practical tool that would allow state authorities to develop indigenous-responsive environmental policies and coping strategies.

The study confirmed that indigenous communities are vulnerable, not only to climate challenges but to the unequal distribution of land and resources such as water and energy. It suggests that their participation in environmental sustainability initiatives is critical; and, indeed, the participants in this study were concerned that their knowledge and experiences were not being taken into account by the government. It is ironic that the democratically elected government that replaced the colonial and apartheid governments still chooses to ignore people's indigenous knowledge.

The inclusion of indigenous knowledge in decision-making can help or hinder strategies related to energy use and deforestation, or water and medicinal plant conservation, among other activities. Forging a negotiated approach for natural resource management – one that takes into account what people say, know and experience – could promote natural resource custodianship and thus greater resilience among indigenous communities. As such, they should be afforded the opportunity to participate in addressing environmental challenges such as climate change and dwindling resources. This could be done by facilitating feedback, debate and a sense of partnership in educational activities and governance.

This paper's main contention is that education in both the environmental and social work fields which incorporates the kinds of IKS described in this paper can work together to address social–ecological concerns which impact the environment, human rights, development opportunities and health of the most vulnerable members of society. Social workers who work in marginalised communities need to appropriately engage with issues pertaining to environmental risk, livelihoods and IKS in order to help families and communities cope with life's stresses and shocks.

The Afro-sensed approach (Masoga & Kaya, 2011:153) contends that 'communities cannot significantly advance in the development of Africa unless those involved in the development process of the continent take African societies and cultures seriously'. In line with the sustainable livelihood approach, local experts should strengthen local capabilities in disaster risk management, traditional agriculture and climatic knowledge by consolidating and spreading IKS through their knowledge and practice.

Notes on the contributors

Lead author

Masoga, Mogomme Alpheus | Faculty of Arts, University of Zululand, South Africa
ORCID: 0000-0002-3335-3633 | Alpheus.Masoga@ul.ac.za

Professor Masoga is Dean of Arts at the University of Zululand. His research interests include Afrikology, cultural history, indigenous knowledge systems, social entrepreneurship and decoloniality studies.

Co-author

Shokane, Allucia Lulu | Department of Social Work, University of Venda, South Africa
ORCID: 0000-0002-2928-1526

Dr Shokane is a senior lecturer in the Department of Social Work at the University of Venda. Her research interests are in social work studies, women's empowerment, community development and indigenous knowledge systems.

Percentage contribution

Areas of contribution	Authors	Percentage contribution
Conception or design of the paper, theory or key argument	Masoga	*50%*
	Shokane	*50%*
Data collection	Masoga	*50%*
	Shokane	*50%*
Analysis and interpretation	Masoga	*50%*
	Shokane	*50%*
Drafting the paper	Masoga	*50%*
	Shokane	*50%*
Critical review of paper	Masoga	*50%*
	Shokane	*50%*

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Viewpoint: Engagement in local social–ecological knowledge practices in a seasonal cycles approach for transitioning to future sustainability

Rob O'Donoghue, Rhodes University, South Africa

Abstract

This paper explores climate as variable natural forces driving seasonal cycles[1] that many African cultures had adjusted themselves to within intergenerational knowledge practices of longue durée. The study points to the need to re-orientate and expand climate science education so that it is centred on the seasonal cycles and intergenerational learning to better align transitioning to future sustainability with these in our southern African contexts of climate change today. The narrative touches upon historical accounts of knowledge practices amongst the Krobo, Bemba, Shona, Zulu and Xhosa, briefly pointing to how each, as an African culture, is situated as a social-ecological entity within the climatic tapestries of our African landscapes. It takes note of how cultural articulation within the seasonal cycles of regional climate have a long history with adaptive change in some contexts in more recent times. The review suggests that our learning in relation to emerging climate change should be informed by these histories of intergenerational knowledge practice. It notes how a better grasp of these could be important drivers of a widening cultural response to the changing dynamics in our climatic surroundings today. The brief study suggests that southern Africa is a special place with many unique and interesting climatic processes and associated socio-ecological systems and practices. These can provide engaging perspectives for informing education to mitigate or adapt to climate change. Here, a situated exploration of seasonal cycles can draw on both the latest in modern climate science and the rich social-ecological heritage of Africa briefly touched upon in the study. A model of process is offered for how both can be used in a seasonal cycles approach climate change education. This better situated and more inclusive approach can enable us to contemplate how we might best adjust our social-ecological dispositions and practices in the changing world that we all share.

Preamble

The current proliferation of education imperatives responding to climate change might be described as colonising disruptions of everyday life where convincing messages convey complex ideas for citizens to become aware of the problem and to confront the prospect of fearful futures unless they can change themselves and the fabric of modern society. Here, communicating knowledge to create awareness, learning and change has been surprisingly ineffective as people appear to become aware of the problem but change towards more sustainable futures is seldom evident or lasting.

This study examines this problem in an African context to contemplate how an effective climate education programme is managing to work with historical evidence. This is necessary to communicate climate science in ways that enable participants to situate patterns of climate change in their context. In this way, networking communities of civic scientists might best

align their futures within the dynamics of the seasonal cycles in their region (see O'Donoghue, Kibuka-Sebitosi, Tshiningayamwe & Palmer (2019), this edition). A seasonal cycles approach in education adds two missing dimensions to current communications. Firstly, the messages are redirected to meaning-making in community and in relation to seasonal cycles, and secondly, these are culturally situated being derived from, and related to, the social-ecological practices of earlier times in the region.

Background

A colonial image of African ignorance has long been overturned by researchers who have revealed a sense of the depth and wisdom in many of the indigenous knowledge practices and cultural responses to climatic variation amongst African peoples. This is still not widely known as most scientific discourses on climate change make little or no reference to heritage knowledge practices or to some of the wisdom in many African intergenerational responses to the seasonal cycles and associated climatic variation in central and southern Africa. It would be interesting to explore how the cultural capital examined in this brief study might be used alongside scientific models of process and to situate, understand and mitigate some of the adverse effects of an anticipated expansion of climate extremes in southern African regions.

In this paper, I briefly sketch some historical evidence of the contours of knowledge on climate and climate variation that are etched in pre-colonial African landscapes and within the cultural heritage of many intergenerational knowledge practices. I have learned of these through the educational fieldwork that I have undertaken with many of my students over the last decade and in my work on Environment and Sustainability Education (ESD) and climate change education at the Environmental Learning Research Centre, Rhodes University. My intention is to challenge and expand on some of the current approaches to climate change education by simply pointing to some gaps that need attention. The paper suggests that African scholars and researchers can make an important contribution to climate science by contemplating the social-ecological heritage of Africa and the knowledge practices of indigenous peoples, many of whom are struggling with harsh conditions of increasing climate variation today.

Through this study, I hope to convey a hopeful sense of how southern Africa is a special place and how our peoples and landscapes hold an exciting social-ecological capital for learning to adjust to the climatic challenges in a changing world today.

Evidence of early African social-ecological adjustment within seasonal cycles

Many scientists find it hard to imagine that earlier societies developed climate forecasting and managed to do so with some success in areas that had fairly predictable seasonal cycles. The climate sciences are much advanced today, but our seasonal forecasting still lacks sufficient accuracy to be wholly reliable. It is not surprising that scientists remain trapped in the reductionist disposition that they know more and better than those who came before them. Many have thus given little attention to African cultural and climatic histories and the intergenerational socio-cultural adjustments in Africa are seldom used to deliberate global

change induced variation in seasonal cycles and to inform future sustainability.

The brief overview of some historical cases of climate related socio-cultural alignment within seasonal cycles opens in one of the most stable climatic systems, the Inter-tropical convergence zone (ITCZ). I learned at school how the ITCZ migrates seasonally with the sun in tropical central Africa bringing warm, wet and cool, dry seasons.

Krobo seasonal cycle of tillage (Ghana)

Norbert Elias, a cultural sociologist, noted how 'seasonal timing' in the agrarian society of the Krobo of Ghana was mediated by tribal 'priests'. Referring to this, Johan Goudsblom (1989) points out how the seasonal calendar available to people is constituted as a socio-cultural capital that was commonly entrusted to priests in early agrarian societies. Here the cooperation involved in seasonal timing was constituted in a social capital of knowledge as '[p]eople always remained dependent upon sun, wind and rain – natural forces over which they could exert no control but to which they could try to adjust themselves to the best of their knowledge' (1989:75).

The spiritual leaders of the Krobo in one area of Ghana are said to have mediated the seasonal cycle of tilling and planting by tracking the movement of the sun until it rose to shine through a crack in the rocks of a hillside. This cyclical process was read alongside an associated building of rain-bearing clouds and all of the villagers waited for the instruction that the season for planting had arrived and they could all go out to till their lands.

Bemba socio-cultural cycles in *chitemene* and *fundikila* (Zambia)

Chitemene agriculture in the Miombo woodlands of Zambia (see Shumba & Kalaba, in O'Donoghue, Sandoval Rivera & Payyappallimana, this edition) is a good example of a socio-cultural process involving similar seasonal timing in a similarly stable high rainfall climatic area. This socio-cultural system has patterns of cultural mediation that extended to a cyclical process of around two decades. One thus not only had the seasonal activities of around five years for the slash and burn tilling of a home area where children were born but an extension of this to around 15 to 20 years. Here, for the young to marry, they had to return to the lands of their birth, thereby enacting an extended fallow period for the forest to recover. This cultural cycle served to restore the ecological consequences of the slash and burn agricultural process that not only effected nutrient transfer from biomass to crop in leached forest soils, but also served to control soil pests with heat and smoke associated with the seasonal burning of arable land before planting with the arrival of the rains. Local farmers in Zambia have noted how the rains coming from the southern migration of the ITCZ from the north often give some early rains to enable ploughing but then, about a month later, daily afternoon rains make it difficult to work the land. The emerging pattern today is that things are more uncertain and that the growing season is now shorter with the first rains now appearing two to three weeks later in the expected seasonal cycle in central Zambia.

In recent history, as the numbers of people increased and the forested areas shrank, a *fundikila* system of agriculture developed in more and more areas as an adaptation of the earlier *chitemene* (Matthews, Holden, Volk & Lungu, 1992). This included seasonal variation in cropping that is

now at the heart of the hybrid system that one finds in the same climatic region today as the onset of the summer season rains is now commonly offset into December. Each successive adaptation has evolved to feed larger populations on the same resource base, but some of the early forest system is now fragmented and at risk.

Mashona seasonal cycle and the Mkuvisi landscape (Zimbabwe)

Similar long-term patterns of socio-ecological livelihood practices are found in the more southern Mkuvisi woodland communities of central and northern Zimbabwe. This served not only to shape the landscape over decades of seasonal shifting agriculture, but to develop seasonal patterns of grazing that were supported by the predominately leguminous trees that fix nitrogen to support the nutritious grasses needed by the Mashona cattle. Here the impact of climatic uncertainty in a climatic region of greater seasonal variation was mitigated by the cultural pattern of agro-forestry that people had adjusted to over many generations until this was disrupted by the colonial intrusion. (See Shava & Masuku in this edition.)

Zulu cycles of hunting and driving (KwaZulu-Natal, South Africa)

Moving south and east in southern Africa one finds the Zululand grasslands that were similarly expanded through the cultural patters of fire use to create pasture commonage and to keep the Nagana cattle disease at bay. Here the cultural shaping of the landscape was less driven by seasonal cycles and more by burning as a response to seasonal change and outbreaks of the Nagana cattle disease associated with the tsetse fly. (See Masuku, in O'Donoghue, Sandoval Rivera & Payyappallimana, this edition.)

Xhosa seasonal migration (Eastern Cape, South Africa)

It is only when one gets further south to the sweet veld grasses of the Xhosa that one finds cultural patterns of seasonal practice in response to more extreme climate variation. This part of southern Africa is an areas of very high climate variation driven by its position in southern Africa at the boundaries of three climatic systems, the Southern Ocean, the southern Indian Ocean and the central African ITCZ. As a boundary space the peoples were subject to high seasonal variability that are now only slightly easier to predict as scientists like George Philander have been able to uncover the working of the El-Nino–La-Nina oscillation in the southern Pacific and how this impacts on the climate of southern Africa and elsewhere.

Using fire in a similar way to the Zulu and Shona, but in a different way to the peoples of northern Zambia, the Xhosa were able to maintain their sweet veld grasses in all but the episodic dry summer seasons. They thus had to adjust themselves in other ways, two of which are notable: (1) seasonal migration to and from the Zuurveld in the south; and (2) *Galesha* (explained below) at the turn of the winter season.

Seasonal migration was not unlike the transhumance of north Africa and the European Alps and other mountainous regions of the world in some ways, but it was more driven by seasonal variation.

Galesha is a particular seasonal cycle/climate variation adaptation that has all but disappeared amongst Xhosa farmers owing to the financial costs of preparing the land for the ingress of

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Engagement in local social-ecological knowledge practices in a seasonal cycles approach for transitioning to future sustainability

water at the end of the cropping season. As Orion's Belt becomes visible in the early winter night sky, farmers would put their cattle into the harvested fields and then plough the soil that had been broken up by the cattle's hooves, turning in the remaining dung, chaff and dry weeds. Denison and Wotshela (2009) describe how this loosening of the soil would allow the light winter rains to be retained in the soil as a rainwater harvesting practice for the coming cropping season. The deeper explanation was, however, more practical, namely that if the rains were late to arrive in a dry season, the pastures would be poor and the cattle weak so they would have to be moved away to the Zuurveld and those remaining to plough would not have the strength to prepare the lands for the summer crops.

Throughout Africa, there are many such narratives that reflect a competency in living within both the usually predictable or highly variable climatic patterns that characterise the social-ecological landscapes and seasonal cycles of Africa.

Decolonising as a situated process of intergenerational learning

As indicated earlier, the above examples are surface stories out of the historical record of the region or in the fabric of rural memories that can be useful to guide action and learning-led change. The historical abstractions and summaries of narrative experiences have been mapped out on these pages to simply point to the richness in the socio-ecological cycles of African peoples on the landscapes of Africa that reflect cultural responses within diverse seasonal cycles. The danger of becoming informed in this way is that the knowledge practices of each of the illustrative cases are not abstract propositions, but are etched in local landscape and seasonal practices mediated within local social structures in Mother Tongue. We cannot simply share narrative accounts of these as has been the colonial education practice.

The Habitable Planet initiative of the CSIR ACCESS programme is notable for an expansion of climate education to the inclusion of the rich heritage and landscapes as these are shaped within the seasonal cycles of history and contemporary society. Its opening strength was the coherent way in which Earth science knowledge was conveyed by inspiring young scientists. The systemic portrayal of the contemporary earth science knowledge was accompanied by an experiential engagement with life experiences of the seasonal cycles in a local context. This included the local micro-climates and the cultural histories of the area, reaching back to geological history and the rich capital of research on early hominids. Two notable areas here have been the Agulhas Bank and the Cradle of Humankind.

The historical evidence of early climate-related cultural mitigation and adaptation processes reviewed in this study are useful for contemplating climate change education as a more situated intergenerational and future-oriented process. This points to the need for a reduction in 'fear-factor' approaches to climate change education where the learning is better situated in African cultural histories and less centrally driven by abstract concepts and processes that are difficult to translate into material practices that are both practical and within reach.

Endnotes

1. Climate scientist Dr George Philander pointed out to me how climate change is a science engaging complex uncertainties where its grasp of tangible effects sheds light on fluctuations and trends in seasonal cycles at global and regional levels. He thus proposed that we look into the cultural histories and seasonal cycles of Africa as a tangible way of working on the question of climate change for our education work in the southern African context.

Notes on the contributor

O'Donoghue, Rob
Environmental Learning Research Centre (ELRC), Rhodes University, South Africa
r.odonoghue@ru.ac.za
Rob O'Donoghue is an Emeritus Professor at the ELRC at Rhodes University. In his research on environmental education processes of learning-led change, he has given close attention to indigenous knowledge practices, social theory and environmental learning in post-colonial curriculum and community contexts.

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Think Piece: Situating Education for Sustainable Development in southern African philosophy and contexts of social–ecological change to enhance curriculum relevance and the common good

Tichaona Pesanayi, Rob O'Donoghue, Rhodes University, South Africa;
and Soul Shava, University of South Africa

Abstract

The study opens with a brief review of how education in colonial southern Africa was steered by a succession of externally framed abstractions that have been implemented within the prevailing hegemony of western modernisation that dominated and marginalised indigenous cultures. It probes how, within an expanding functionalist framework, Education for Sustainable Development (ESD) has been similarly constituted as a proposition for implementation. Here the supposition is that implementing ESD as an intervention will transform education into an inclusive and collaborative pedagogy that will shape competences for participants to transform society towards a sustainable future. In an effort to explore the possibility of making a break from a succession of education imperatives functioning as 'salvation narratives' to put things right in Africa, the study explores ESD from a more situated and emergent vantage point within African landscapes, philosophy and cultural practices. This requires a shift from a view of ESD as a perspective to be brought in and enacted to foster change, to ESD as a situated engagement in education as a process where relevance is deliberated and brought out in quality education with high order skills. This perspective exemplifies working with a more fully situated framing of deliberative social learning for the common good. It is explored here to contemplate how socio-cultural processes of deliberative ethics and co-engaged reflexive processes of learning-led change might emerge. Here, also, using a capabilities approach might provide useful starting points for ESD as an expansive process of transformative social learning.

An historical vantage point on early education in Africa

Read in historical relief, it is possible to see that education was commonly initiated from outside and functioned 'behind the desired times to come'. In South Africa, for example, colonial education was part of an inscriptive marginalising of indigenous peoples and their cultures to produce a colonial future. Here an early colonial education focus on literacy played out in times when the production of a literate labour force and consumers was a driver of the expanding imperial juggernaut of modernist globalisation. Into modern times of a slow–down in socio–economic development and emerging environmental problems, the curriculum reflects a shift to a foregrounding of mathematics, science and technology education for skills development to revitalise the economy and reduce risk in the modern cosmopolitan state. This has shaped a modern, 'risk society' (Beck, 1992) with education imperatives to foster entrepreneurship and also to mediate environmental degradation through inclusive processes of transformative social

learning (TSL). Here, in simplified overview, the past century of social–ecological change can be seen to have shaped the emergence of early Environmental Education (EE) and an expansive concept of Education for Sustainable Development (ESD) that is currently being merged into a forthcoming focus on Global Citizenship Education (GCEd) for sustainable development (O'Donoghue, 2014).

An accompanying transformation of the commons

Mukuvisi Woodlands – a small fragment that is a remnant of the earlier Miombo woodlands of Harare today – is now a wildlife park containing eland, a large cattle-like herbivore of the African woodland, amongst other ungulates, and a wide variety of birdlife. These fascinate tourists today as they look over a wetland, now waterhole, and enjoy each other's company in a wildlife park that is within the city limits of Harare. The woodland landscape of rich grassland that reaches out into shaded woods is, however, also the cultural landscape of the Shona, a fire-modified ecosystem of grasses and trees where people thrived with their cattle and where perennial streams watered cattle and homestead food gardens. Today, despite the drought of an El Niño year intensified by emerging climate change in the region, the water is still evident, although the wetland has been partially drained so that it no longer extends into what are now the eastern suburbs of the modern city of Harare. The Shona people in Harare, like indigenous peoples all over the world, are now part of a modern cosmopolitan state within which there is an urgent need for ESD to mediate learning-led change towards a more sustainable future.

The Mukuvisi Woodlands Environmental Education Centre and its woodland ecosystem are an outcome of the colonial game laws and the introduction of preservationist approaches to wildlife conservation. The indigenous people had homesteads that were surrounded by wildlife that were hunted for food, but this began to change as much of the wildlife was decimated by colonial hunters. These changes and the need to conserve dwindling wildlife emerged alongside the need to control the rampant Nagana cattle disease in the hotter lowveld habitats and accompanied the Rinderpest that swept through southern Africa at the turn of the 20th century and into the present, when we have episodic outbreaks of foot and mouth disease. These and other factors contributed to a separation of cattle and wildlife with the colonial creation of wildlife parks that are iconic tourist destinations today.

The colonial processes of intrusive change and the advent of parks produced a curious inversion (O'Donoghue, 1996) for indigenous communities as over a relatively short period, they moved from living in homesteads surrounded by wildlife to many living on the borders of conservation areas from which they were excluded (Brockington, Duffy & Igoe, 2008). From a lifestyle of being surrounded by wildlife that they hunted together, particularly in the lean, dry winter months, many came to live around parks that they and their cattle were excluded from. These and other slow changes, like the advent of cities, shaped a modern nature/humankind dichotomy both on the now diverse agricultural landscapes and in the intellectual field of ecology that came to be centred on interactions of maintaining natural systems and processes upon which all living things depend. Within this emergent discipline of wildlife ecology that came to inform the modern professional fields of environmental management, the landscape

was primarily read as natural systems under the threat of change (habitat loss) in modern times of rapid change owing to rampant human expansion and development. This disposition, rooted in modern processes of economic expansion, was starkly evident in the park as a separate wildlife sanctuary for natural habitats where wild things could thrive. This is evident in how many of the parks stand in stark contrast to the human environments around them today and the environmental sciences are underpinned by an ecological idealism founded in colonial fascination with wildlife and wild areas in Africa.

Here ecological and wildlife management research came to constitute a self-validating theory in defence of its founding disposition that parks were developed on natural landscapes that people in Africa had not occupied and impacted (Murombedzi, 2003). For example, numerous studies were undertaken by Ezemvelo KZN Wildlife in collaboration with other management authorities to try to establish the natural baseline for the fire management regimes. This research excluded human-induced fires and their assumed destructive effects and thus came to be centred on lightning strikes. The problem of needing a baseline for the management of grassland and bush encroachment had developed from the 1950s and 1960s as wildlife areas that excluded human influences began to thrive and grasslands for the desirable herds of ungulates that tourists came to see began to recede in areas like the Hluhluwe-Umfolozi Park, for example. It was only into the 1990s that landscape ecologists began to deduce that the expansion of the grasslands and the creation of the African savanna landscape was an outcome of centuries of environmental management by indigenous peoples.

In both the Miombo woodland landscape of the Shona and the Hluhluwe-Umfolozi landscape of the Zulu, the processes used the same medium, fire, but to differing effect. The expansion of the Zululand grasslands developed from the upland into the wooded lowlands, opening up the woodland and creating riverine woodlands. Here the patterns of burning established home ranges for cattle from which wildlife and the Nagana cattle disease were excluded by circular hunting and driving practices. In the case of the Miombo woodlands, it was similarly a cultural landscape produced over millennia of human–nature interactions. Winter and early spring burning with the onset of the rains was centred on the wetland, woodland and riverine areas that were essential for producing the nutritious grasses for summer grazing when the sun was fierce and palatable grasses thrived with the rain and the shade of the trees. Added to this, the Miombo woodlands of southern Africa comprise treed savannah grasslands dominated by indigenous tree legumes of the *Brachystegia* and *Julbernadia* genera that produce the necessary nitrogen for grasses to proliferate with the rains. In Zimbabwe, these trees include the *musasa* (*Brachystegia speciformis*), *mupfuti* (*Brachystegia boehmii*) and *munhondo* (*Julbernadia globiflora*). The Shona people have interacted with the Miombo ecosystem and it has been shaped and sustained by and for their livelihoods, which include mixed farming (livestock husbandry and crop cultivation) as well as harvesting of wild resources for food, medicine and for raw materials.

The Shona grazing activities include the timed regular burning of the grasslands – *kupisa sango* (to burn the woodland or forest) – in the grazing commons (*mafuro*) – to remove the dry grass biomass at the end of dry winter season, enabling nutritious grasses to emerge at the beginning of the summer rainfall season. The predominantly annual grasses are adapted to this

fire regime, as are the deciduous tree legumes, which have a thick bark that withstands the regular fires and flush (produce new green leaves) just before the beginning of the summer rainfall. The regular burning is associated with nutrient release.

The naming of the trees is also associated with the Shona people's knowledge of and uses for them. The *munhondo* is so called because in the dry winter season the dry legume pods crack open due to desiccation, producing a loud clapping noise. Clapping in Shona – a traditional ritual done by the sons-in-law to their in-laws and also by the young to the elders as a sign of respect – is called *kurova nhondo*, from where the term *munhondo* is derived (wives also clap to their husbands (and in-laws) as sign of respect, as do people when they meet leaders and also as a means of thanking somebody for receiving something or for a good deed done). The *musasa* tree is so termed because its branches are usually used to make a shelter, *kuvaka musasa*, or to fence a field. The inner bark is normally used as bark rope, *rwodzi*, to tie together the branches making the shelter or poles used in making the sides and roofs of houses. The *mupfuti* tree is so called because of its ability to easily and quickly develop new shoots from the coppice of a cut down tree. The tree trunks and branches are used for construction and also as firewood. *Pfuti* is the Shona term for gun. The Shona have a wood harvesting practice in which either the branches are lopped off the trees or the trunk is cut down leaving the tree base (coppicing). Such a wood harvesting practice enables the regeneration of the trees and the recovery of the woodland in the harvested area over time. Similarly, their land preparation practice for cultivation, slash and burn, is done in such a way that when the land loses its natural fertility, it is abandoned to lie fallow (*dongo*) and regenerate into natural woodland.

The evolution of Miombo woodlands and the other grassland landscapes of southern Africa are closely associated with the cultural practices of the indigenous peoples such as the Shona and Zulu. It is interesting to note here that the association of the Shona people with the Miombo savannah and its development as a socio-ecological (biocultural) landscape is not part of the environmental education processes at the Mukuvisi Woodland Nature Reserve and the Environmental Education Centre in Harare. The same is the case in the Hluhluwe-Umfolozi parks despite the evidence of the hunting pits of King Shaka that are part of the cultural heritage programme for visiting schools and international tourists. Such rich indigenous heritage needs to be incorporated as part of the unfolding discourse on the history of these sites through transformative educational processes that decentre the western hegemony of nature conservation, which tends to prioritise the rights of wildlife over the rights of dispossessed indigenous communities. A re-contextualising discourse in education can pave the way to an inclusive co-existence of plural histories of place that enrich the deliberative learning experiences in these nature reserves.

Framing ESD to restore sustainability to The Commons

Read in simplifying overview, it is possible to track how the transformation of The Commons (Hardin, 1968) and changing education practices have been 'behind the desired times to come'; in this case, a modern era of risk where there is now a need for ESD to foster transformative change. The educational change is currently playing out in models of processes and social

imaginaries for producing sustainable futures. Over times of past change, education, not unlike ESD today, has developed as similarly abstracted propositions to be enacted as 'salvation narratives' for producing a desirable future. The colonial past of education reflects an exploitive paternalism, initially to save the native with western forms of literacy and to privatise The Commons so that it became the productive resources of citizens and corporate business in a modern capitalist economy.

In response to emerging risks resulting from the last century of rapid social–ecological change, and not unlike in the recent past when conservation and environmental education were advocated, ESD has now emerged as a model of transformative processes for enabling necessary learning-led change towards a sustainable future. In each case, the envisaged practices for enacting the desired future have not had sufficiently situated models of process for co-engaged participants to mediate desired change. It is becoming apparent that, by approaching education in this way, the educational practices for getting to a desirable end have been surprisingly elusive.

ESD as a concept for implementation to foster transformation

Over the past decade or so, ESD has emerged as a concept to foster transformative social learning in curriculum settings and expanding education contexts of reflexive social–ecological change. The past United Nations Decade of Education for Sustainable Development has served both to shape and to clarify ESD as a proposition for implementation in five priority areas through a Global Action Programme (UNESCO, 2014) towards transformative learning for future sustainability. Against this broad picture, the question that this paper explores is: how has the modern enactment of education imperatives developed as somewhat blind processes 'behind the desired times to come' when better times have seldom been realised in African contexts of emancipation and empowerment through education? ESD is a compelling proposition for learning-led social–ecological change. It has developed as a response to change as a somewhat arbitrary modernist outcome within escalating socio-economic and political risk. The enactment of ESD as an education process is thus a concern that merits careful review so that it might best be situated and realised through quality education practices that play out in ways that are relevant in emerging African contexts of modernity.

The search for an alternative to an externalised functionalist pedagogical enactment of transformation for enabling students to give effect to social–ecological change is not an easy matter and yet there is evidence of how, working within an African philosophical perspective, students on the margins of modernity have been able to produce and sustain transformations that have enabled them to be successful in modern schooling.

Situated processes of collaborative self–empowerment, literacy and healthy living

Madzima (2012) describes how, in conditions of poverty and socio-economic collapse in Zimbabwe, a group of young black learners from marginalised communities were successful at school where others failed. She describes how their success was achieved through a sustained collaborative effort, where they drew on cultural resources to transcend the innumerable

barriers that they faced in daily life and in a schooling system that brought numerous other literacy, learning and assessment task challenges. She writes: 'It was found that they drew strongly on Shona Hunhu cultural resources. These enabled them to become successful despite the daunting conditions in which they found themselves' (Madzima, 2012).

In this way, the learners constituted realities that enabled them to be successful 'through their own local truths and worldviews' that she notes had hitherto been silenced, excluded or remained unrecognised within a dominant '"Western Canon" and its education system'. She goes on (Madzima, 2012) to elaborate how:

> Consistent with *hunhu* philosophy, all learners believed they were made in the image of Musikavanhu or Mwari/Great spirit who blesses both the poor and rich as long as they prayed and worked hard to do good and become *vanhu chaivo* (people of substance) and not *marombe* (worthless animals). The absence of a strong, moral and coherent subjectivity is conclusively *hapana zvemunhu* (there is no person there). They respected and listened to the precepts and stories of *hunhu* wisdom from their parents and community – loving, working together with, sharing, respecting and protecting *mhuri* (immediate and extended families) and friends. *Munhu chaiye aripo anozvibata* to attain *hunhu* (a real person of substance is able to hold him/herself together to attain dignity).

She notes how they worked together, forming 'Groupworks' so that they collaborated on learning tasks. Here they described to her how they would not have been successful in passing their exams without working in a way where they 'pooled intellectual and pedagogic resources' to establish a learning community of collaborative purpose and mutual support.

Within the education system of a modern African state, here one finds the social tools and ethical dispositions for the children to create their own successes within a system of education that might enable them to be successful in a changing modern world. Their task is, however, a lot more than this as they must not only be mediated to enter the world of work but the world that they are entering is in need of restorative change.

In another study on relations between home and school where *Ubuntu* was an important process of solidarity and collaborative endeavour, Maqwelane (2011) found that the inclusion of indigenous knowledge practices through interactions with their grandmothers (*Gogos*) enhanced literacy and learning in Foundation Phase learners. Her focus was on 'intergenerational healthy living practices' (Maqwelane 2011: ii) that she explored in collaboration with grandmothers on literacy skills in the life skills curriculum. This interactive process served to contextualise the curriculum content in ways that gave the students a relevant foundation for learning to read and write as well as address health issues by exemplifying their heritage knowledge practices.

Both cases reflect situated agency developed through a process of collaborative engagement that draws on indigenous cultural resources to foster success in schooling, suggesting that heritage resources might be important for well constituted models of process like ESD to be brought into useful effect as a foundation for learning to thrive and transcend social–historical processes of marginalisation.

Towards a situated socio–cultural foundation for ESD

The Global Action Programme envisaged that modern governments should be supported to situate and enact the abstract concept of ESD as a purposeful activity that produces quality education that is relevant to the times to come. This education must, however, also be relevant to the context and to the peoples that are part of the African landscape of risk in need of change. It is from this vantage point that ESD must be embedded in relation to the social–ecological landscape in ways that activate the cultural capital of the plural cultures within the tapestry of history. In this case there are 16 local languages/dialects across the modern African state of what is Zimbabwe today and a common thread that they all share is *hunhu-ubuntu*, a philosophy of the socio–ecological landscape and commons of southern Africa. Samkange (1980) notes how the philosophy that is rooted in southern African culture was both situated in the region in diverse dialogical forms and shaped within the socio–political struggle to emerge an African philosophy of *Ubuntu*. Today *hunhu-ubuntu* appears to have the necessary situated attributes to provide a necessary philosophical foundation for ESD. Madzima (2012) notes how:

> *Hunhu* is the ethnic, democratic intrinsic-drive success model that helps explain how and with which resources marginalized youth manoeuvre through hostile institutions as they choose to generate cognitive structures and the conditions of their success. Although the storylines of their home and upbringing were interwoven within multiple layers of material impoverishment (i.e. finance, food, clothing, accommodation and education), their identities were unfixed. Through strict discipline and conduct, each embodied learner worked hard to cross, straddle and leap over borders and boundaries whether they were conceptual, structural, cultural, spatial, or temporal.… In turn, these were used in constructing what learners figured were necessary multiple social identities to assist the construction of viable and sustainable academic identities.

Within this research it is possible to note how the philosophy is not only a source of cultural resources to enable collaborative education endeavours but a disposition that resonates with the commons of modernity that are producing risk at a global level.

A situated framing ESD in curriculum practice

Hunhu-Ubuntu provides a situated capital of commons and community propositions for a deliberative enacting of ESD as a reflexive model of process for expansive learning. It provides the shared cultural capital for framing ESD within emergent socio-cultural processes of meaning-making for narrating learning and change. Deliberative ethics are a necessary capital for reflexive learning as these enable learners to draw on a capital of cultural dispositions and life experiences to raise questions and take up critical vantage points for a dialogical engagement with issues and risk. Here they are also able to situate, contemplate and model The Commons, change-over-time and the common good.

Current ESD training initiatives – such as the ongoing southern African regional teacher training programme in ESD, Sustainability Starts with Teachers (Lotz-Sisitka, Tshiningayamwe

& Urenje, 2017), coordinated by UNESCO – need to take into consideration the complex power–knowledge dynamics in situated socio-ecological contexts of practice in southern Africa in an effort to reframe ESD discourses for greater contextual relevance and epistemic resonance. The re-contextualisation of environment and sustainability concerns in ways that articulate with local social–ecological life experiences and indigenous knowledges can foster deepening understanding and resonance amongst educators and learners.

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